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Blending a Constructivist Theory of Teaching and Learning with Indigenous Knowledge Systems in the Official Natural Science Curriculum in Phongola Schools, Kwazulu Natal

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Abstract: The study investigated the techniques that could be used to integrate Indigenous Knowledge Systems (IKS) into the formal Natural Science (NS) curriculum in Phongola schools. A qualitative research approach was adopted. Interviews, focus group discussions, observations and document analysis were used to collect data. Headmasters, NS Heads of Departments (HODs) and NS teachers were purposively selected to participate in the study. The study's findings revealed that integrating IKS into the formal NS curriculum would allow IKS to blend with the child-centred constructivist approach to teaching that is advocated for by CAPS 2012 NS curriculum documents. The constructivist approach calls for teachers to teach learners from the known to the unknown. What learners already know in Phongola schools is IKS which they use on a daily basis in their communities. The study recommended that for successful incorporation of IKS into the formal NS curriculum the Ministry of Basic Education should review its policies and embrace IKS as a full knowledge strand in the formal NS curriculum, provide adequate IKS resources in schools. The Ministry of Basic Education and publishers should research and document IKS in official NS study material. Teachers should be trained and empowered with detailed IKS information.

Keywords: Indigenous Knowledge Systems, Constructivism, Natural Science Curriculum.

INTRODUCTION

In the last quarter of the 20th century right into the 21st century, the call for a paradigm shift from the boring teacher-centred approach to an interesting learner-centred approach gained momentum. This can be achieved if learners' prior knowledge is used allowing teachers to move from the known to the unknown and from simple to complex concepts. In African communities, Indigenous Knowledge Systems (IKS) form the basis of the learners' prior knowledge, because learners interact with and make use of this form of knowledge right from birth. The South African Natural Science Curriculum and Policy Statement documents popularly known as CAPS 2012, call for the abandonment of the teacher-centred approach and the adoption of the child-centred approach. These documents call for the use of IKS in the formal Natural Science curriculum. The perusal of official NS study resources proved that there was little or no IKS content in the teachers' guides and learners' guides in Phongola schools where the study was conducted. One of the objectives of undertaking the study was to generate the techniques that could be used to incorporate IKS into the formal NS curriculum in schools. This article is based on the findings of a qualitative study that was conducted in Phongola schools using interviews, focus group discussions, document analysis and observations. Participants of the study were Headmasters, Natural Science Heads of Departments (HODs), and Natural Science teachers. The article begins by discussing a strong relationship that exists between a constructivist teaching and learning theory and IKS. After this discussion, the article proceeds to articulate the techniques that can be employed to incorporate IKS into the formal NS curriculum. These techniques were generated from participants in the field who were in support of the call of incorporating IKS into the formal NS curriculum in South Africa. Since CAPS 2012 NS curriculum documents call for the adoption of the constructivist child-centred approach when teaching NS in schools, the study revealed that this approach can only be effectively implemented in schools if it is blended with IKS. In order for this blending to be practised the beginning point is to incorporate IKS into the formal NS curriculum, hence the study generated the techniques that can be used to achieve such incorporation.

LITERATURE REVIEW

Literature was reviewed to enable the reader to understand the constructivist theory of teaching and learning and how it relates to IKS. Literature was reviewed under the following themes: Constructivist teaching and learning theory, teaching and learning building on Indigenous Knowledge Systems, as well as techniques of incorporating IKS into the formal NS curriculum.

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Constructivist Teaching and Learning Theory

Mackinnon & Scarff- Seatter (1997); & Teets & Starnes (1996) argue that constructivism in the past years has gained notable attention in the field of education, formulation of education policies including delivery of instruction in schools and institutions of higher learning. Philosophers such as John Dewey who founded progressive education currently absorbed as part of constructivism opposed principles of education that promoted rote learning via memorisation (Daudin, 2016). According to Daudin (2016), learners should be taught through facilitation and real-life experiences as opposed to rote memorization. Cognitive constructivists such as Jean Piaget also believed that learners should learn through discovery method when they are ready to learn as opposed to learning through passive assimilation of given information. Jerome Brunner influenced by Levy Vygotsky, built on Socratic traditions that learning should be through dialogue and encouraging learners to be involved in the construction of their own knowledge. Bruner emphasised the use of instructional scaffolding whereby learners are given support by experienced adults and teachers until they develop their own learning strategies. Most adults in communities where learners come from possess rich and comprehensive information on IKS than on Western Knowledge and science. The majority of adults cannot help their children in their school work that is laden with Western Knowledge (WK), such knowledge is unavailable to them and also irrelevant to their daily activities in communities.

Brunner also argued that learning should be a process of discovery where learners build their own knowledge by making use of their already existing knowledge through engaging in dialogue with their peers and teachers. It can therefore be argued that the knowledge that learners primarily possess is indigenous knowledge that they acquire from their families and communities right from birth. Nieman & Monyoi (2016:7) argue that 'many constructivists believe that learning should take place in a realistic and authentic setting.' Authentic setting referred to here is the local context which is rich with IKS. It is therefore essential for NS curriculum to be carefully designed and integrate IKS so that learners can use it to build Western science concepts. Doing so will enable them to learn from the known (IKS) to the unknown (Western Science Knowledge). Doudin (2016) asserts that Vygotsky (1934) argued that culture and language play a crucial role in children's cognitive development and on the way how they perceive they perceive the world around them. Both language and culture are inbuilt in learners' IKS. It is essential to note that IKS forms the foundation of a constructivist learning theory. Constructivism can only be successfully implemented in the NS curriculum if it is blended with IKS. Canella & Reiff (1994); & Richardson (1997) argue that in constructivism students build their own knowledge and understanding through interactions of what they already know and believe, with ideas and activities that they come into contact with. When learners go to school what they already know and believe in is IKS hence the need to blend constructivism learning theory with IKS in the NS curriculum. Currently, the CAPS 2012 NS curriculum documents have not yet incorporated IKS as a knowledge strand. In most NS official study material IKS is not included. In a few sources where it is included, it is too brief and not all that informative.

Teaching and Learning Building on Indigenous Knowledge Systems

Brunner said that in order for learning to be meaningful and successful it should be scaffolded (Doudin 2016). IKS is seen by Srikantaiah (2005) as the best scaffold for learning. Of interest Srikantaiah (2005) asserts that the constructivist approach to teaching and learning can only be successful if it makes use of IKS in the school curriculum. He sees the prior knowledge of learners as composed of IKS. It is imperative to note that learners' prior knowledge plays a significant role in the implementation of a constructivist approach during instructional delivery in class. A constructivist approach requires teachers to utilize what learners already know as the foundation of their learning. It can be argued that in most South African communities where schools are located what learners already know is IKS that is used in their daily routines in life. Taking this into account South African NS curriculum developers need to blend the constructivist approach to teaching and learning with IKS if this approach is to be successfully implemented. Srikantaiah (2005); & Vadeboncoeur (1997) argue that the first pedagogical technique in a constructivist approach that should be considered as important by teachers is the recognition of learners' prior knowledge, which should be thought of as IKS.

Techniques of Incorporating IKS into the Formal NS Curriculum

It was revealed in the study that in schools IKS is not yet incorporated into the official curriculum and study material. This is despite the Ministry of Basic Education's CAPS 2012 NS curriculum documents calling for its incorporation. CAPS 2012 NS curriculum documents call for the adoption of a constructivist learner-centered approach in the teaching and learning of NS in schools. Jacobs (2015); & Srikantaiah (2005) argue that for a constructivist theory of teaching and learning to be successfully applied in class it should be supported by Indigenous Knowledge which forms the basis of learners' prior knowledge.

Since official NS curriculum has not yet incorporated IKS despite CAPS 2012 NS curriculum documents calling for its incorporation the study generated techniques from participants that could be used to incorporate IKS into the official NS curriculum.

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Different ways of incorporating IKS into the school curriculum have been suggested by different researchers. Jacobs (2015) believes that teachers should be trained in order to successfully incorporate IKS into the formal school curriculum. The findings of his study show that teachers who attended workshops and were trained and were trained on how to incorporate IKS into the formal science curriculum were more confident in handling IKS in class than their colleagues who were not trained. Jacobs (2015) seems convinced about IKS content that is generated by short term workshops. It is however necessary to state that IKS generated through workshops is not detailed enough to drive a formal NS science curriculum. IKS has vast and rich content which should be incorporated into the formal NS curriculum holistically and undiluted.

Phiri's (2008) study reveals that in Malawi only exclusive Indigenous Technologies were incorporated into the Malawian Primary school Science and Technology curriculum. Phiri (2008) however expresses that scientific IK is broad and it was supposed to be broadly integrated into the formal curriculum in Malawi than only integrating indigenous technologies.

RESEARCH METHODOLOGY

The study used a constructivist research paradigm and a qualitative research approach. Dolan & Donnelly (2009); & Creswell (2007) assert that qualitative research enables the researcher to get first-hand information from participants about the phenomenon straight from the site where the phenomenon is located. The qualitative approach enabled the researcher to physically go to Phongola schools to interact with participants face to face during interviews and focus group discussions on how IKS could be incorporated into the NS school curriculum. The researcher also made observations and analysed documents to check the extent of IKS incorporation into the NS curriculum and official study material.

Purposive and convenient sampling techniques were used to select the study's participants and schools. McMillan & Schumacher (2010) argue that researchers should select people who will participate in the study because it is not possible for the whole population to participate. The population included Headmasters, NS HODs, and NS teachers in Phongola schools. Trustworthiness was ensured through using the four constructs identified by Creswell (2007) as credibility, transferability, dependability and confirm ability. Different data collection methods such as focus groups, interviews and document analysis were used in order to triangulate data and check for similarities and differences and reasons behind identified variances. Ethical guidelines were abided by through seeking for permission to conduct the study in Phongola schools in writing from the Department of Education offices in KZN provincial offices in Pietermaritzburg. The Department issued an authorization letter allowing the researcher to conduct research in Phongola schools. Before taking part in the study participants signed consent forms with ethical guidelines that they were given by the researcher.

PRESENTATION OF FINDINGS AND DISCUSSIONS

Participants came up with impressive techniques that can be used to incorporate scientific IKS into the formal NS curriculum. Responding to the question: Which techniques/methods can be used to incorporate IKS into the formal NS curriculum successfully? Participants said that the following techniques were essential for the successful implementation of IKS into the formal NS curriculum in schools:

- Policy review
- Budgeting for IKS
- Documenting IKS into official NS study material
- Training teachers on IKS

Policy Review

Participants in Phongola schools said that the Ministry of Basic Education (MBE) should review its policy and create a clear framework of incorporating IKS into the formal NS curriculum. At school, C and school E participants saw the review of the MBE policy and the South African Schools Act No 84 of 1996 as the beginning point for the incorporation of IKS into the NS school curriculum. They said that review of these documents would set up a framework for the incorporation of IKS into the NS curriculum as a full knowledge strand. Policy review can blend IKS and the child-centred constructivist approach to teaching that is advocated for by CAPS 2012 NS curriculum documents. IKS would therefore act as the basic foundation in the teaching and learning of NS in South African schools. Making use of IKS this way would make sure that this valuable form of scientific knowledge is saved from extinction.

One of the Headmasters argued that if IKS is not in the formal school curriculum teachers cannot teach it, because policy spells out what should be taught in the formal NS curriculum. In the CAPS 2012 NS and Life Science curriculum documents, the Department of Education recognizes IKS and affirms its importance in Science education. These policy documents expect teachers to integrate IKS in class when delivering their lessons. It should however be noted that these documents emphasise the use of IKS supplement lessons whose content is filled with Western Knowledge. The policy documents do not legally empower IKS to be a full knowledge strand in the formal science curriculum. The policy only instructs teachers to integrate IKS when delivering Western science, without even stating which categories or type of IKS should be integrated. It can therefore be argued that the policy views and presents IKS as junior to

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Western Knowledge (WK). Brown (2000) is concerned that after independence African governments have continued with colonial policies that denigrate IKS in order to serve the interests of their colonial masters.

Participants had a vital point that the Department of Education (DoE) should revise its policies in order to broadly and holistically embrace IKS as a full knowledge strand in the NS school curriculum. The CAPS (2012) NS curriculum documents are not explicit on how teachers are supposed to incorporate IKS in their lessons. Seemingly discretion on the incorporation process is left to individual teachers. This means that the process becomes haphazard and uncoordinated. In order to avoid this unpleasant scenario the CAPS (2012), NS curriculum documents should spell out the categories and content of IKS that must be incorporated into the formal NS curriculum. Participants in Phongola schools argued that the Ministry of Education policy documents should be consultatively reviewed so that they embrace a framework that would comprehensively incorporate IKS in an orderly manner.

The review of education policies is further necessitated by Jacob's (2015) study which revealed that teachers did not have sufficient IKS knowledge to teach learners confidently. Participants in Phongola schools raised the same concern during focus group discussions. They asserted that the majority of teachers especially the young generation lacked knowledge on IKS, and the situation was further aggravated by lack of resources with IKS information in schools. It is therefore imperative for the DoE to review its policies as a matter of urgency and allow the generation of IKS official study material sufficient enough to support IKS as a full knowledge strand in the NS school curriculum. Learners who are knowledgeable in IKS would have an opportunity to excel and be motivated to pursue sciences as a career if IKS is incorporated as a knowledge strand in the school science curriculum. The meaningful existence of IKS in the NS school curriculum would also blend well with the constructivist learner-centred approach to teaching and learning in class. Such a blend would promote the advocacy of CAPS 2012 NS curriculum documents that call for a shift from the teacher-centred approach and adoption of the constructivist's child-centred approach. A child-centred approach strives on utilising learners' prior knowledge. The bulk of learners' prior knowledge comprises of IKS, hence the call for the incorporation of IKS into the formal NS curriculum so that principles of constructivism and IKS content can blend perfectly during instructional delivery in the NS class.

Budgeting for IKS

Participated argued that the government in consultation with the DoE should budget and allocate incorporation of IKS into the school curriculum enough resources. A Natural Science HOD in school D said that:

> *The government should come up with a sufficient budget to incorporate IKS into the Natural Science curriculum, promote IKS centres, research, and promote IKS custodians in communities.*

The HOD further stated that without adequate budgets shortages of IKS resources would continue to prevail in schools and inhibit successful incorporation of IKS into the formal NS curriculum. At school B the Headmaster raised similar sentiments. He expressed that failure of projects in schools is a common feature due to paucity of necessary resources. He said:

> *Teachers might be willing to incorporate IKS into the curriculum, but if there is no government support in the form of budgets and resources such an initiative is likely to face some challenges.*

Resources are crucial for the success of any initiative in schools. Successful incorporation of IKS into the NS school curriculum would not be feasible without necessary resources. Though CAPS (2012) NS curriculum documents highlight in passing that teachers should integrate IKS in their lessons, participants said that the DoE's 2017 budget did not have a specific allocation for the incorporation of IKS into the formal school curriculum. They said that there was no budget allocation even for developing official IKS study material for NS curriculum or for training teachers on IKS. Participants believed that DoE policies should address issues of IKS budgets and resources. Documenting IKS into official NS study material.

In most African schools there are still serious shortages of IKS study material Shizha (2007); Dei (2000). In Phongola schools in the KwaZulu Natal Province of South Africa, an analysis of official NS study material such as Platinum Natural Science learners' Book 9 ninth impression 2014, Hennings (2014) Natural Science Learners' Book 8, the Natural Science Teachers' Guide Grade 8 – A (CAPS) 2017, and the Natural Science Teachers' Guide Grade 8 – B (CAPS) 2017 revealed that IKS is nonexistent in some of these sources while it only makes a paragraph in some of them. This proved that IKS is not yet documented in the official NS study material.

Participants in Phongola schools argued that NS textbooks do not information on IKS, which makes it a challenge for those teachers who wanted to use IKS in class. They suggested that in order to make the incorporation of IKS in the NS school curriculum a success, the DoE should work with communities, schools and publishers to document and publish IKS in official NS study material. A Headmaster at school B said that:

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> *If Indigenous Knowledge is to be integrated into the Natural Science curriculum, the Ministry of Basic Education and publishers should publish books in Indigenous Knowledge for use by teachers and students. The books that are used now do not have information on Indigenous Knowledge.*

The Headmaster went on to argue that the DoE and Publishers should work closely and in collaboration with parents to research and document official IKS study material for the NS curriculum. He asserted that:

> *Parents should be involved in the development of Indigenous Knowledge study material since they are still using Indigenous Knowledge in their communities. There is a lot of science happening in communities that NS researchers and book publishers can be interested in……..*

The Headmaster went on to say that, if researchers and t publishers work with parents they would get rich IKS information for documentation in official NS textbooks. During focus group discussions conducted at school E participants argues that publishers can publish IKS study material in two ways. 1. IKS material can be published comprehensively in its own textbooks, teachers' guides and learners' books, 2. IKS material can be published as a full knowledge strand in the official NS study material currently used in schools. Teachers said that if this succeeds then the long-awaited scenario of having IKS existing side by side with WKS as equals in official science study material in schools would become reality.

Shizha (2007) advocates for the incorporation of IKS into the school curriculum textbooks in schools so that teachers and learners are not only guided by information from Western textbooks and study guides. An analysis of official NS study material showed that NS learners and in Phongola schools are guided by NS Learners' hand-books and teachers' guides that filled with Western science only. In some of these sources, IKS is nonexistent while in some of them it is only a paragraph. Since South Africa has IKS Policy 2006, the DoE can leverage on the existence of this policy and public official IKS study material for the NS curriculum.

IKS was recognized as scientific In the Budapest agenda of 1999 during the world conference on science. The DoE should ride on this recognition and the existence of the South African IKS Policy 2006 and document IKS study material and incorporate it into the official NS curriculum. Science should not be narrowly defined, but it should be broadly defined beyond uninformed definitions of Western colonial imperialists. Science is not a Western preserve as colonisers portray it. All world nations possess their valuable scientific knowledge and skills which should be utilized for the development of local communities and beyond.

The definition and documentation of IKS should be broader, and it should go beyond simplistic and narrow perceptions of Western colonialists' views and perceptions on what science is. Catherine & Hoppers (2017) argue that the Budapest 1999 agenda defined science broadly. It defined science as an expression of human creativity both individual and collective. Since creativity has diverse expressions, science, therefore, ought to be a pluralistic enterprise that easily refers to ways of knowing. Catherine & Hoppers (2017) proceed to argue that science should not be restricted to Western science, but it should include the knowledge systems of diverse cultures. Taking this into account, time is now for the DoE and publishers to do the much-awaited justice and conduct comprehensive research, and publish IKS learners' and teachers' guides for the successful incorporation of IKS as a full knowledge strand in the NS school curriculum.

Training Teachers on IKS

Wang (2006); Shizha (2007); & Dei (2001) see teachers' negative attitudes towards IKS as emanating from teachers' training colleges where IK is lowly regarded. Participants in Phongola schools argued that institutions that train teachers have not yet incorporated IKS into their teacher-training curriculum, and as a result, these institutions produce teachers who do not have much interest or information on IKS. 'Courses that are done in many teachers' training colleges do not incorporate IKS into the science curriculum and pedagogical practices' (Shizha, 2007:314). In light of this, it is mandatory for the DoE to in-service teachers who are already in the field to empower them with information on IKS. Participants emphasized that teacher training is an essential component in the incorporation of IKS into the NS school curriculum. The Headmaster from School E argued that:

> *In order to train teachers effectively in Indigenous Knowledge, the teacher training institutions should incorporate Indigenous Knowledge into their curriculum, and the Ministry of Basic Education should organise Indigenous Knowledge workshops to in-service teachers who are already in the field. In-fact, the Ministry of Basic Education should also organise outreach programmes to sensitise parents about the importance of incorporating Indigenous Knowledge Systems into the school curriculum……*

Parental involvement is always needed for the success of projects initiated in schools. In this scenario, parents are the ones who encourage their children to embrace IKS at school IKS at school and also effectively lobby the DoE to embrace IKS holistically into its policies. Teacher training would change teachers' attitudes towards IKS, and empower them with knowledge which will motivate them to embrace in the official NS curriculum. Jacobs' (2015) study proved that teachers who were trained were more

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confident, motivated and effective in using IKS in class than those who were not trained. It can therefore be argued that according to Jacobs' (2015) study teacher training is an important instrument that should be used by the DoE to empower teachers with IKS knowledge in order to encourage them to play a major role in the endeavour of incorporating IKS in the official NS curriculum.

CONCLUSIONS

From participants' contributions and review of literature, it can be concluded that IKS should be incorporated into the formal NS curriculum in order to blend it with the constructivists' child-centred approach, which was introduced in the CAPS 2012 NS curriculum documents. The child-centred approach requires teachers to teach learners from the known to the unknown. What children already know in Phongola schools is IKS which is the basis of their prior knowledge, hence there is need to blend a constructivist child-centred approach to teaching and learning with IKS in the official NS curriculum documents.

It can also be concluded that for IKS to be successfully incorporated into the official NS curriculum, certain techniques need to be employed. The Ministry of Basic Education needs to review its policies and acknowledge that IKS is a scientific knowledge that needs to be incorporated into the formal NS curriculum documents as a full knowledge strand. The Ministry as well should budget for IKS and build its resource capacity at all levels in the education system.

Another conclusion drawn is that for IKS to be meaningfully incorporated into the NS curriculum the Ministry of Basic Education, and publishers should carry out detailed research and document IKS in official NS learners' books and teachers' guides. After IKS has been documented in the official NS study material teachers should be trained and empowered with IKS information. Such training will not only make NS teachers knowledgeable in IKS, but it will also make them change their negative attitudes towards IKS. After the training of teachers, schools should bring parents on board and sensitise them about the importance of incorporation of IKS into the official NS curriculum. The final conclusion that has been drawn from the finding is that teacher training institutions should incorporate IKS into their teacher training programme curriculum.

Recommendations

The following recommendations were made based on literature review, research findings and conclusions drawn:

- The Ministry of Basic Education should review its policies and include IKS as a full knowledge strand in its policy documents, specifically in the CAPS 2012 NS curriculum documents. Such a review should blend the CAPS' 2012 constructivist child-centred approach with IKS which form the foundation of this approach.
- The Ministry of Basic Education should in-service NS teachers who are already practising in the field and empower them with IKS information.
- The Ministry of Basic Education and publishers should research and document IKS as a full knowledge strand in official NS study material such as learners' books and teachers' guides.
- Schools should engage parents and sensitise them about the importance of incorporating IKS into the official NS curriculum.
- Teacher training institutions should incorporate IKS into their teacher training curriculum.

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