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USING A LEARNER-BASED ACTIVITY APPROACH IN DEVELOPING SCIENCE TEACHERS' READINESS IN INQUIRY-BASED LEARNING

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Abstract

The South African science curriculum expects secondary school teachers to adjust their ways of teaching to include inquiry-based learning that endorses learner-based activities. The learner-based activities refer to the processes of learning by doing where learners are not passive, but are rather encouraged to actively participate in their own learning experiences. This paper is necessitated by the limited literature that exists within the South African context about inquiry-based learning, which reveals that the implementation of learner-based activities continues to be a challenge for many teachers, especially in rural schools. Hence, during the teacher training program, the Physical Science teachers were engaged in various learner-based practical activities which involved problem-solving, which is a crucial component of inquiry based learning. This paper therefore drew from the constructivist theory (Vygotsky,1975; Piaget,1980) as lens to answer the leading research question which asks: "To what extent are the science teachers demonstrating readiness of the use of inquiry-based learning in their classrooms after participating in the training program?". Thus, a mixed method design was adopted where data was collected using as well as pre and post questionnaires to establish the Physical Sciences in-service teachers' beliefs and experiences towards their readiness in implementing inquiry-based learning in their classrooms after the teacher development program in one of the education circuit in rural Kwa-Zulu Natal province, in South Africa. The findings of this study indicates that the in-service teachers in this district had an impactful experience which positively shifted their attitudes towards their readiness of the use of inquiry based learning when teaching Physical Sciences.

Keywords: *Inquiry based learning, in-service teachers, constructivist theory, learner-based activity, community of practice.*

1. Introduction

The South African schooling curriculum has had a long history of changes in the past two decades which have all placed different expectations on science teachers' pedagogical practices. For example, the current curriculum used across all nine provinces in no-fee paying schools of South Africa known as Curriculum Assessment Policy Statement (CAPS) has a strong focus on Inquiry Based Learning (IBL) which is stipulated under specific aim two. Generally, specific aim two seeks to serve as a guiding tool for science teachers on how best to develop important skills amongst their learners such as scientific processing and scientific reasoning, which are all globally regarded as core skills for a scientific literate citizen (Mokiwa, 2014; DBE, 2011). Although, there is growing advocacy on IBL, teachers in South Africa still struggle to implement this approach due to various factors (e.g., lack of time, infrastructure, resources, and knowledge). Within the South African context, schools are categorized into five quantiles, which is a ranking system that was adopted by the Department of Education from the Apartheid system to categorize schools based on their socio-economic factors (Hall, Leatt & Rosa,2009). Quantile one to three schools are no-fee-paying schools that are usually located within impoverished areas, while quantile four to five are private schools, usually in affluent areas of the country. This study was conducted at the district of Zululand, where most of the schools are classified as quantile one. In one of the few studies that was conducted by Ramnarain and Hlatshwayo (2018) in similar schooling context within the Mpumalanga province found out that although the Physical Science teachers had a positive view and acknowledged the benefits of the use of IBL in their classrooms, they however did not know where they will begin with its implementation. The study further revealed that the Physical Science teachers' difficulties of the use of IBL in their classrooms was presented by numerous factors such as lack of resources and infrastructure. Hence, this study used a learner-based activity approach during a teacher training program to develop science teachers'

readiness in inquiry-based learning. The first phase of the program was interested in understanding the type of beliefs that the science teachers in the Zululand district held about the use of IBL in their classrooms and it was guided by the following research question:

- What are the physical science teachers' beliefs about the implementations of IBL in their classrooms in the Zululand district?

2. Defining IBL

IBL is a widely researched area across various disciplines (see: NGSCC Lead States, 2013; National research Council,2012). However, as revealed by the studies of Ramnarain and Hlatshwayo (2018) as well as that of Ranmnarain (2016) it is revealed that the field of IBL is relatively a new field in the South African context. The concept of IBL refers to an approach that involves 'learning-by-doing' and it is grounded within the constructivist ideologies of T&L. IBL in its nature has an active approach learning where learners are provided with opportunities to investigate problems, search for solutions, make observations and answer questions, hence its significance within science classrooms. The vast research conducted within the field has provided numerous benefits that are associated with the use of IBL in science classrooms which involve but not limited to:

- Helping students make their own connections of the presented content
- Build students problem solving, comprehension, critical thinking skills and cognition.

Essentially IBL is a pedagogy which best enables students to experience the processes of knowledge creation and the key attributes are learning stimulated by inquiry, a student-centred approach, a move to self-directed learning, and an active learning approach. That is why this study used the learner-based activity approach which positioned the teachers to assume learner roles during the training, so they could be provided with first-hand experience that would enable them to see IBL in practice and its benefits.

3. The impact of teachers Beliefs on the use of IBL

This paper was interested in understanding science teachers' beliefs that are associated with the use of IBL in the Zululand district, North of Kwa-Zulu Natal province. Calderhead (1996) defines beliefs as "suppositions, commitments, and ideologies that teachers have about their students learning of the subject matter" (p.715). Beliefs are considered to be an important of area to be researched, especially in IBL because they influence teachers pedagogical reasoning and instructional practices (Sikko, Lyngved, & Pepin, 2012). As further exemplified by Binns and Popp (2013) If a teachers' core belief is inconsistent with IBL pedagogies, they may serve as a barrier for teachers when employing inquiry as a T&L strategy in their classrooms (Binns & Popp,2013). Hence, Ramnarain, Nampota and Schuster (2016) explain that the way in which teachers teach is usually embedded by their belief systems. That is why this study used the learner-based activity approach during a teacher training program to develop science teachers' readiness in inquiry-based learning.

4. Method

This paper adopted a quantitative survey approach (Creswell, 2014). The questionnaires comprised of different items that were administered to the Physical Sciences teachers on the first day of the workshop in the rural district of Zululand, Kwa-Zulu Natal, South Africa. Twenty-three Physical Sciences teachers responded to the questionnaire, and the teaching experience of these teachers in the profession ranged from a few years to more than 25 years. All the teachers were from the poorly resourced school with no laboratories and with many learners per class. A Science Curriculum Implementation Questionnaire (SCIQ) adapted version was used (Lewthwaite, 2001), which is currently referred to as the Scientific Inquiry Implementation Questionnaire (SIIQ). The SCIQ was used to evaluate factors influencing science program delivery at schools in Australia, New Zealand and Canada and in other numerous research publications such as (Lewthwaite 2004, 2005; Ramnarain, 2016). SCIQ has forty-nine-item, and in this study only fifteen items were used. The items are statements to which teachers respond to on a 5-point Likert scale that ranges from 1 (strongly disagree) to 5 (strongly agree). Given that Ramnarain (2016) used the same instrument within South Africa, it was therefore not necessary to conduct a piloting study. The descriptive statistics, i.e. mean scores and standard deviations, were computed to identify general trends in their beliefs for each item.

5. Data analysis and findings

The mean scores were computed to identify the general trends in responses for each the items, and standard deviations were computed to determine the degree of consistency amongst the teacher's responses. The results were grouped according to each item, and table 1 shows the means for each item, that were used to document the types of beliefs that science teachers have about IBL, thus determining their readiness of use of IBL in their science classrooms.

Table 1. The overall means and SD for each item

Statements	**Mean scores**	**Standard dev**
IBL takes up too much of my teaching time	4,09	0,83
It is difficult to maintain control of learners during IBL	3,26	0,94
I prefer my learners to *design* their own inquiries	3,48	0,83
IBL helps my learners to develop experimental process skills	3,87	0,74
My head of department supports the way in which teaching is done in my class	3,61	0,87
The purpose of doing an inquiry is to confirm theory	3,74	0,94
I feel confident teaching lessons where learners do science inquiries	3,87	0,74
Science inquiry activities are difficult to manage	3,09	1,02
The management of my school could do more to support me in implementing the inquiry-based approach to practical work	3,78	0,98
I borrow apparatus from other schools	3,57	1,01
The lesson time allocated is adequate for my learners to do practical work/Inquiry activities	2,52	1,31
My learners take a lot of time to settle down before starting with the inquiry activities	3,35	1,05
When I need lab equipment and chemicals the management of my school makes funds available for the purchase of these	2,61	1,28
With the new curriculum, I now include more practical activities in my teaching	3,09	1,06
My learners are well behaved when they are doing practical work	3,35	0,87
Overall scores	**3,42**	**1,07**

The overall findings were (M=3,42; SD=1,07) which revealed that teachers who attended this workshop had a positive belief about IBL. Although that is the case, the results still showed that the physical science teachers that participated in this study also had a belief that IBL takes up too much of their teaching time (M=4,09; SD=0,83), a number of them do not believe that school management is willing to purchase lab equipment and chemicals (M=2,61; SD=1,28), and majority of them do not believe there is enough time for learners to do practical work/inquiry activities (M=2,52; SD=1,31). These results were consistent with those of Ramnarain and Hlatshwayo (2018)'s that despite the positive beliefs that science teachers have about IBL, they still are less positive in implementing the IBL approach in their classrooms because of resource-related issues such no laboratory facilities and T&L materials to mention a few.

The results were then groups in terms of their teaching experience to further establish the science teachers' beliefs about IBL as shown in Table 2. This was done as means of tracing whether or not the number of teaching experience had any influences in the physical science teachers' beliefs about implementing IBL in their practices.

Table 2. Mean score in terms of teaching experience.

Years of teaching	**# of teachers**	**Mean score**	**Standard deviation**
0- 5	6	3,30	1,14
6-15	12	3,52	1,05
16-25	2	3,37	0,98
< 25	3	3,27	1,04

The findings in table 2 further illustrated that physical science teachers that were between 6-15 years of teaching experience had a stronger belief towards IBL compared to other groups. Therefore, the findings of this study show that the rural Zululand district Physical Sciences teachers had a strong belief about IBL as the mean scores were above the value of 3.

6. Discussion of results and conclusion

To respond to the research question 'What are the Zululand District Physical Sciences teachers' beliefs about inquiry-based learning?" The findings show that the sampled Physical Sciences teachers from the Zululand district displayed a strong belief in inquiry-based learning (M=3.46). This is a noteworthy finding since the CAPS documents advocate the implementation of IBL at school. The findings of this study are in line with (Ramnarain et al., 2018), that teachers from the rural district of Mpumalanga had a positive attitude towards inquiry in the teaching and learning of Physical Sciences and recognise the benefits of inquiry, such as addressing learner motivation and supporting learners in the understanding of abstract science concepts. Based on these findings, it is recommended that future research should be pursued in investigating whether or not these teachers adopted IBL in their classrooms, and what kind of support do they still require if any to sustain the use of IBL in their practices.

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