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Diversity in educators' personal and cultural worldviews: the South African context for science and technology pedagogy

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ABSTRACT: The South African Revised National Curriculum Statement of 2002 acknowledged that science and technology educators and their learners bring different worldviews to the classroom. This study subsequently identified and classified the nature of different worldview presuppositions held by a sample of 504 science and technology educators in 2006 in the Western Cape. Five different types of educators' worldviews were established using the *My Idea About Nature* (MIAN) profile. In this article, the author presents the data obtained for the scientific worldviews of the educators, analysed in detail by gender and the educator's present level of instruction. The findings support the curriculum assumption that educators in the Western Cape hold a multiplicity of worldview presuppositions. There were also significant differences detected by gender and the educator's level of instruction. The author concludes by discussing how the worldviews of the educators may influence their teaching styles and their selection of pedagogical content in science and technology in the context of African indigenous knowledge systems.

INTRODUCTION

In South Africa, the Natural Science and Technology policy documents of the Revised National Curriculum Statement (RNCS 2005) encourage the inclusion of indigenous knowledge systems in the classroom implementation of the curriculum [1][2]. The documents also state that the learners themselves *bring different worldviews to the classroom*. Therefore, educators are encouraged to begin at least some of their instruction with an exploration of the prior knowledge that the learners themselves bring to the classroom.

Many studies have been conducted by researchers worldwide to seek the ways and means to implement culturally sensitive curricula that also address learners' indigenous knowledge systems [3-5]. The main purpose of those studies was to help educators to integrate the teaching of engineering and science with local indigenous knowledge. Their main assumption was that the science and technology educators themselves should have an adequate understanding of indigenous knowledge and how it could be integrated in the teaching-learning process with students who manifest a diversity of local religious, cultural and social belief systems [4].

Nevertheless, in South African engineering textbooks, as well as in science and technology educators' resource guides, by 2006, relatively little had been undertaken to reflect indigenous knowledge in the curriculum in practice, although scattered examples had been included. Consequently, indigenous knowledge is still not always being taught by educators nor reflected in the teaching-learning process. The prescribed current curriculum content has no specified, clear and well-directed indigenous knowledge target at which to aim, so educators with different worldview perspectives are free to choose individual aspects and local examples in their instruction when they feel inclined to do so. Different worldview perspectives include the following examples:

- Scientific;
- Rational;
- Pseudoscientific;
- Spiritualistic;
- Metaphysical;
- Magical;
- Mystical;
- Para-psychological.

BACKGROUND AND RATIONALE

For the successful classroom integration of scientific, technological and indigenous knowledge systems, it is claimed that an educator who is a *culture broker* of science and technology is needed *to help the learners move back and forth between their indigenous culture and the culture of Western science* [6].

South African society is multicultural. Educators in Southern Africa are increasingly finding themselves in lecture theatres, workshops, laboratories and classrooms with learners from cultural backgrounds that differ from their own. Therefore, one consideration is that educators ought to understand more about different local cultures in order to relate more closely to their students from different cultural backgrounds [3]. Educators are confronted when explanations propagated by the worldviews of the learners are in conflict with scientific explanations. Furthermore, both western as well as non-western learners may also bring commonly occurring superstitions to the classroom.

PURPOSE

The purpose of this paper was to seek answers to the following research questions:

- When invited to respond to five presented worldview scales, namely: *science*, *rationalism*, *spiritism*, *pseudoscience* and *magic*, how did a sample of 504 South African science and technology educators score on each of these five perspectives?

- Focusing on just one of the worldviews, namely *science* as the dependant variable, were there significant differences in the responses to the scale when analysed in terms of the independent variables: gender, type of school, population group, language, religion and qualifications?

THEORETICAL APPROACH

This study was situated within the framework of *worldview theory* as presented by Fakudze, Ogunniyi and Emereole [7-9]. They considered that the worldviews of *educators* themselves may play an important role in the teaching and learning of science and technology. How meaningful learning occurs from instruction will depend in part on the *degree of congruence* between the worldview assumed by the educator and that of the learners. This is especially true for western educators who teach cross-culturally. Some educators who are university-trained may also assume that western science/technology is the only authentic knowledge system. However, sometimes learners will bring to the classroom alternative ideas, beliefs or experiences that work, but which appear to be in conflict with explanations offered by western science, engineering and technology.

Allen and Crawley found that the worldviews that certain learners brought into the science classroom may have affected not only how they made sense of scientific information, but also the extent to which they were willing to participate in the educational experience – according to the impressions of outsiders (guests) in the science classroom [10]. Jegeda and Okebukola also claimed that the learners' own socio-cultural backgrounds brought to the classroom may cause a *pedagogical wedge* between what the educator teaches and what they actually learn [11]. Furthermore, if the socio-cultural background of the learner generates an attitude that is indifferent to the formal learning of science and technology, the learner may find it difficult – or perhaps impossible – to learn science, engineering and technology effectively.

METHODOLOGY

The main method used to generate data in this research study was survey sampling. Sample surveys can provide accurate estimates about the features of the population they portray.

To assess the worldviews of the educators, a slightly modified version of the instrument known as *My Idea About Nature* (MIAN), after Ogunniyi, was administered to a widespread sample of educators in the Western Cape [8]. The MIAN had reliability coefficients ranging between r = 0.85 and r = 0.95, using the Spearman Rank Difference formula [7-8].

The MIAN questionnaire had two parts. Part A elicited the respondent educators' demographic information. Part B contained eight fictitious narratives about selected natural phenomena related to science and technology. Each story was introduced by a statement or group of statements about people's ideas and beliefs about various natural phenomena, such as lightning, earthquakes, magnetism, traditional healers, etc. The responding educators were required to express their *agreement*, *disagreement* or *no opinion* with regard to five plausible explanations offered below each narrative. Space was provided below each story in which each respondent was expected to generate and write his/her own view about the phenomenon described.

The response items under the eight fictitious stories were grouped into five major categories, namely: *magic & mysticism*; *metaphysics*, *parapsychology & pseudoscience*; *spiritism*; *rationalism;* and *science*. These traditional worldviews had been classified by Ogunniyi and Yandila according to the following descriptive criteria:

1. Science: appeals to objectivism, reductionism, mechanism, etc;
2. Pseudoscience: appears to be scientific but contains erroneous conceptions;
3. Rationalism: appeals to reason or *common sense*;
4. Mysticism: appeals to another world of gods, spirits, etc [9].

The same classification was adopted for this study. The five categories into which the stories were grouped were developed by Ogunniyi et al and verified by other researchers, eg Fakudze [7][8]. Each of the five options under each story was assigned a number, which resulted in 40 items in the modified version of the MIAN questionnaire.

The sample consisted of 504 respondents (204 males and 300 females) from approximately 120 high schools and primary schools in the Western Cape, South Africa. Principals of schools were approached and the nature of the study was explained to them. Heads of science and technology departments were asked to act as coordinators to distribute the questionnaires and return them to the researcher.

RESULTS

The large scale study produced a number of findings. Table 1 represents the mean scores for the five different worldviews as determined by the MIAN.

Table 1: Mean scores for the five different worldviews.

Worldview	No. of Items	Maximum Possible Total Score	Mean Total Score	Mean Score %
Science	4	4	2.13	53.3
Rationalism	4	4	1.51	37.8
Spiritism	12	12	2.43	20.3
Pseudoscience	14	14	4.10	29.3
Magic & mysticism	6	6	2.03	33.8

The worldview *pseudoscience,* for example, contained 14 items, each scoring one mark for a predetermined response (either *agree* or *disagree,* as appropriate), yielding a maximum possible score of 14 for a pseudoscientific worldview. Because the respondents were science and technology educators, one would have expected that the highest mean score would have been obtained for expressing a *scientific* view of the world. Although this did occur, nevertheless it was well below 100%.

For the purpose of this brief article, only two findings are reported in more detail. The prevalence of the *scientific* worldview response was analysed in terms of the selected independent variables. Surprisingly, only 38% of the science and technology educators in this study held a coherent *scientific* worldview (as determined by the MIAN). Moreover, only 8% of the 504 educators recorded a fully *scientific* worldview. This is worrisome because these respondents are educators who are presently teaching science and technology to learners.

Figure 1 presents the distribution of scores generated by the sample of 504 science and technology educators for the *scientific* worldview (measured by the responses to items 8, 17, 31 and 34 combined) with a maximum possible score of 4.

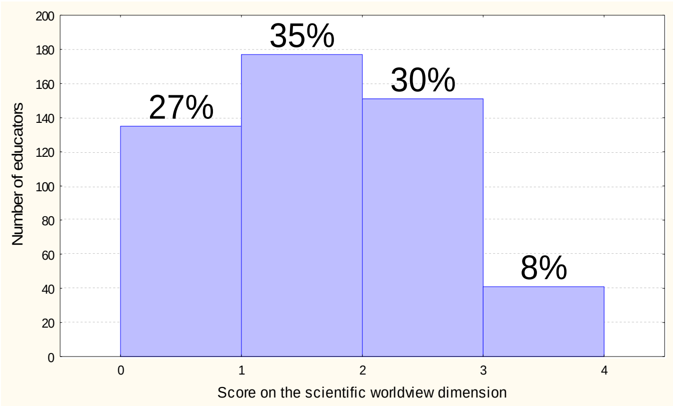

Figure 1: Distribution of scores for the *scientific* worldview among science and technology educators (N = 504).

By comparison, Figure 2 presents a quite different distribution of scores generated by the sample of 504 science and technology educators for the *rational* worldview (measured by items 2, 6, 13 and 25 combined) with a maximum possible score of 4.

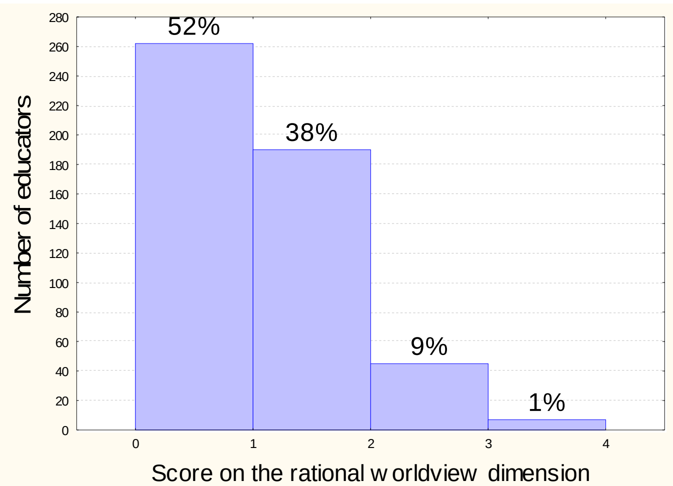

Figure 2: Distribution of scores for the *rational* worldview among science and technology educators (N =504).

Further Analysis of the *Scientific* Worldview by Gender

There was a statistically significant difference ($p < 0.05$) between the responses of the 204 male and 300 female science and technology educators when grouped according to gender. In this study, the male educators were more *scientifically* inclined in their worldview responses then the female educators (chi-square = 3.69; n = 504).

Further Analysis of the *Scientific* Worldview by the Educator's Instructional Level

There was a statistically significant difference ($p < 0.05$) between the responses of the 183 high school and 321 primary school educators in science and technology when grouped according to instructional level. In this study, the high school educators were more *scientifically* inclined in their worldview than the primary school educators (chi-square = 3.85; n = 504).

Other Variables

With regard to the other independent variables, namely: *population group*, *language*, *qualification*, *religion*, *learning area taught* as well as *experience*, there were no statistically significant differences between the response scores for the dependent variable *scientific* worldview.

DISCUSSION

Competent, motivated, dedicated science and technology educators are the key to successful reform in education.

However, before any cross-cultural science and technology teaching can be implemented, educators' own views with regard to including indigenous learners' everyday culture into western school science might be understood. Indeed, it has been stated that *Educational reform can only be successful if the knowledge, beliefs and attitudes of the teachers who are involved in the reform are taken into account* [12].

To improve science learning, current thinking is that educators ought to know more about the influence of local culture on science/technology learning. Consequently, some educators are developing strategies to include acquiring knowledge of relevant aspects of the cultural background of the learner as part of the normal teaching/learning process.

The worldviews of educators might also play an important role in the style of teaching and learning of science and technology. How meaningful learning evolves from instruction may depend in part on the degree of congruence between the worldview of the educator and that of the learner. This is especially true for western educators who teach cross-culturally. Some educators who are university-trained may also assume that western science/technology is the only authentic system of knowledge. However, sometimes learners and their teachers bring to the classroom certain ideas, beliefs or experiences that appear to be in conflict with western science/technology.

Educators are not always aware of the magnitude of the cultural gaps that exists between western and non-western interpretations of reality. Educators should be aware that learners do not come to the science classroom with *tabula rasa* minds. In the African context, learners can come to the classroom with a worldview that may not be scientifically *correct* as a result of their cultural backgrounds. Therefore, *educators should make a concerted effort* to identify those elements of the learners' cultures that differ with the scientific culture and to treat the elements of the learners' culture with the appropriate care they deserve [13].

Sometimes, the science and technology learnt in schools, technikons and universities by non-western learners is perceived and judged by them as having little or no relevance to their daily lives when they hear only first world scientific concepts in the classroom.

Many African and western learners underachieve in school science and technology; and one of the reasons given is the perceived low relevance of school science taught to both types of learners in relation to their everyday circumstances. To make the western science more relevant for learners in developing countries, teachers should also focus on indigenous knowledge [14]. According to Swift, cited in Engida, *The greater the indigenous knowledge and the less the imported knowledge, the more likely it is that the latter will be assimilated and used* [15].

Figure 3 is an example of African indigenous knowledge systems presented in a *PowerPoint* presentation by Prof. Silas Lwakabamba, Rector of the Kigali Institute of Science, Technology and Management (KIST), Kigali, Rwanda [16].

Figure 3: Biogas production for families.

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