

## **An Exploratory Perspective into the Factors Associated with the Shortage of Physical Science Teachers in the Further Education and Training Band**

**Tebogo Mogashoa**

*University of South Africa, College of Education, Department of Curriculum  
and Instructional Studies, Republic of South Africa  
E-mail: mogasti@unisa.ac.za*

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**ABSTRACT** The aim of the research was to explore the factors associated with the shortage of Physical Science teachers in the FET Band. This paper was underpinned by conceptual model, developed by Howie on school effectiveness in order to foreground possible factors influencing the shortage of Physical Science teachers. A positivist-interpretive quantitative research approach was employed for the purpose of conducting this research. Descriptive statistics was used to summarize, organize and reduce large numbers of observations extricated from the participants' questionnaires. It has been established in this paper that the lack of incentives contributes to the shortage of Physical Science teachers, since the majority of the respondents strongly agreed that there were no incentives to spur them on to teach Physical Science. The majority of the respondents strongly agreed or agreed that Physical Science is portrayed as belonging to a man's world. In order for the teachers to be abreast with issues pertaining to their discipline, there is a need for the education authorities to provide them with professional development.

### **INTRODUCTION**

The purpose of education is to develop learners and enhance their knowledge, as well as to equip them with the skills that they could use when facing challenges in life. Central to the acquisition of knowledge and skills is the teacher who actively engages the learners, as critical co-investigators, in the teaching and learning processes (Gultig et al. 2012). Thus, a more democratic relationship should be cultivated between the teacher and the learners. The knowledge and skills acquired by the learners are embedded in the subjects that they specialise in as they progress with their education. Some of these subjects are perceived as 'sacred' or vulnerable strategic subjects (Murphy and Whitelegg 2013) since, as the learners progress with their learning, their numbers gradually decline, resulting in the pyramid pattern enrolments. Subjects or learning areas such as Physical Science experience a decline in the number of learners who pursue them at universities and colleges of the FET. It is imperative that education specialists and policy makers ascertain the reasons behind the decline in the number of learners who specialise in Physical Science.

The shortage of Physical Science teachers is one of the nagging issues for governments and educationists alike globally (Boutelle 2010;

Cochrane 2010; Mathews 2011; Rundquist 2009; Woolhouse 2012). The recurring adage posits that some teachers believe that not all learners can do science, since it is in the preserve of the intellectuals (Maqutu 2013). Shai (2010) observed that some of the graduates choose careers in the private sector and not in the teaching profession, thus resulting in only a few specialist Physical Science teachers. In the researcher's view, it is essential that teachers or policy-makers sanction more research at tertiary level that will examine the reasons why the graduates opt for other professions, since the current research focuses on the FET Band classes. The educators should acknowledge the fact that there are some imminent challenges within the education system that need to be unravelled and addressed, since they affect the availability of specialist Physical Science teachers, hence the learners' performance in Physical Science (Sheriff 2005).

It is anticipated that this paper would provide some invaluable information to education stakeholders, that is, education planners, administrators, directorates and science teachers, on the factors influencing the shortage of specialist Physical Science teachers. However, according to Murphy and Whitelegg (2008), research should examine teachers' perceptions on those learners who can and those who cannot do Phys-

ical Science. The findings of this paper are likely to furnish the education stakeholders with the reasons behind the shortage of specialist Physical Science teachers in the FET Band classes. This paper aims to fill the gap of locally-based research on the reasons for the shortage of Physical Science teachers in the FET Band classes.

### Objectives

The objectives of this paper were to investigate the factors associated with the shortage of Physical Science teachers in the Further Education and Training Band classes and to explore the consequences associated with the shortage of such teachers.

### Theoretical Framework

The literature that underpins the research was first drawn from the findings of other countries, eventually narrowing it down to the local context (Maree 2007). The literature, amongst others, comprised information sourced from books, magazine articles, journals, newspaper reports, education websites and databases. A conceptual model, developed by Howie (2003) on school effectiveness, was employed in order to foreground possible factors influencing the shortage of Physical Science teachers in the FET Band classes. The model shares the same sentiments as those developed by (Craig 1996; Heneveld 1998S; Cheerens 1990). Howie's model comprises three facets - inputs, processes and outputs - and serves as a significant theoretical and conceptual basis for the analysis of the paper.

Howie's model is, to a greater extent, informed by the work of Shavelson et al. (1987). In this model the education system is presented in terms of "inputs (including contexts), processes and outputs" (Howie 2003). The inputs comprise policy-related contexts operational at the national, regional and local or school level that inform the design and development of the intended curriculum. In this case, what is taught and learnt at the local level (FET Band) are Physical Science concepts. The concepts are impacted by the human resource, namely, Physical Science teachers. Howie (2003) contends that inputs also encompass some antecedents comprising the economic, physical and human resources. The antecedent that the paper focused on is the Physical Science teacher.

The second facet of Howie's model pertains to processes or educational practices that are affected by the inputs. A lack of appropriate and competent input has a negative effect on the attainment of outcomes (Mogashoa 2014). These processes relate to what is being taught and how it is taught, and occur in the schools and classrooms. The content of Physical Science is what is taught by the human resource at school level, using different teaching methods.

The last facet in Howie's model is the 'outputs', also regarded as 'outcomes', which are manifested in terms of the learners' achievement in specific subjects, such as Physical Science. The other outputs are learner participation in class activities, their attitudes towards some subjects, and future aspirations. A significant assumption in the learning of Physical Science is that learners learn both independently and through collaboration, for example by doing experiments. Collaborative learning requires that the learning environment accommodates the learners' active interaction with one another to optimise their achievement in Physics (Akinso-la and Ifamuyiwa 2008).

### RESEARCH DESIGN AND METHODS

A positivist-interpretive quantitative research approach was employed in the conducting of this research (Maree 2007). Empirical quantitative research methods were employed to collect the data. *Empirical* means guided by evidence that is acquired from systematic research methods, as opposed to opinions, or to authorities (McMillan and Schumacher 2010). This paper follows the cross-sectional design as a microcosm of the survey, since data were collected at a single point in time in a school setting (Gay 2006; Ross 2005). In short, the research method for this paper is informed by the quantitative approach, encompassing the non-experimental design, which subsequently embraces the survey design.

The population in this research comprises 201 Physical Science teachers in the FET Band classes in the Mpumalanga Province of the Republic of South Africa. The main reason for tapping on the opinions of the teachers from this province is that they do not equally receive resources. Some of the districts have more resources which attract the best teachers in the profession. Most of the teachers aspire to teach in the

districts which are also easily accessible due to various modes of transportation. The schools that were sampled from these districts are representative of the number of Physical Science teachers in the whole of the Mpumalanga Province.

According to Maree (2007), *sampling* can be regarded as a process of selecting a portion of the population that will be used in a study. In this paper, the probability sampling procedure, which is based on randomisation, was used to obtain the sample of FET Physical Science teachers (De Vos et al. 2002). This means that the respondents were drawn from the large population (FET Physical Science teachers) in such a manner that the probability of selecting each member of the population was equal. It was anticipated that the probability sampling procedure would efficiently provide estimates of what is true for the population of Physical Science teachers from a smaller group of respondents (Berends 2006; Maree 2007). McMillan and Schumacher (2010) indicate that *stratified random sampling* is a variation of simple random sampling, while Maree (2007) considers it as a direct subset of the probability sampling method. However, they both concur that it is encompassed in the probability sampling methods. Stratified random sampling was employed in this paper, since the population was based in urban and rural settings.

The data were collected by means of written questionnaires, which were placed in an envelope at the District Education Offices together with a cover letter or letter of transmittal, outlining the study (McMillan and Schumacher 2010). The envelopes were distributed to the principals when they came to attend meetings. Also, an explanatory note was enclosed in the envelopes requesting the principals to return the questionnaires when they came to attend the meeting for the following month.

According to Cohen et al. (2000), data analysis involves the organising, accounting for and explaining of the data. In retrospect, the research approach for this paper was quantitative. Quantitative research relies heavily on numerical data in reporting to results (Maree 2007). The paper employed descriptive statistics to summarise and present the data. McMillan and Schumacher (2010) contend that "...the use of descriptive statistics is the most fundamental way to summarise data, and it is indispensable in interpreting the results of quantitative research". De-

scriptive statistics described the opinions of the Physical Science teachers in the sample and this is acceded to by Ross (2005). In this paper descriptive statistics was used to summarise, organise and reduce large numbers of observations extricated from the teachers' questionnaires. The statistics transformed a set of numbers or observations into indices that described or characterised the data. Mogashoa (2014) insists that it is always imperative for the researcher to maintain trust and confidentiality when analysing data.

## RESEARCH FINDINGS

### The Factors that Influence the Shortage of Physical Science Teachers

In analysing the descriptive data, statements were formulated regarding the factors associated with the shortage of Physical Science teachers. The respondents were asked to state the extent to which they *agree* or *disagree* with each statement listed in Table 1 which reflects their opinion according to the scale that follows:

- |       |   |                   |
|-------|---|-------------------|
| 1. SD | = | Strongly disagree |
| 2. D  | = | Disagree          |
| 3. A  | = | Agree             |
| 4. SA | = | Strongly agree    |
| 12.0  |   |                   |

## CONCLUSION

Physical Science requires a strong mathematics background and has more abstract concepts than the other sciences. There are few Physical Science role-models and Physical Science is portrayed as a 'man's world'. The learners have a negative attitude towards Physical Science. There is a lack of opportunities for professional development. The teachers are faced with a number of challenges, for example, insufficient learner discipline, and are overloaded, as they are not replaced after retirement.

## RECOMMENDATIONS

The recommendations are two-fold, since they focus on both the teacher and learner, and government should support them at policy and institutional levels. The Department of Higher Education and Training (DHET) should provide

**Table 1: The shortage of Physical Science teachers (n = 168)**

| S. No.            | The shortage of Physical Science teachers is due to the following factors: | Mean | Std. dev. | SD1 | D2  | A3   | SA4         |
|-------------------|----------------------------------------------------------------------------|------|-----------|-----|-----|------|-------------|
| <i>Incentives</i> |                                                                            |      |           |     |     |      |             |
| 1                 | The salary is not attractive.                                              | 3.50 | .726      | 1.8 | 8.3 | 28.0 | <b>61.9</b> |
| 2                 | There are no incentives.                                                   | 3.55 | .608      | 1.2 | 2.4 | 36.5 | <b>59.9</b> |

Santiago (2002) and Vegas (2005) argue that Physical Science teachers leave the teaching profession because of other incentives and because of a meagre salary. The majority of the respondents strongly agreed or agreed (96.4%) that there were no incentives to attract Physical Science teachers, nor attractive salaries (89.9%). It can be concluded that the lack of incentives contributes to the shortage of Physical Science teachers, since the majority of the respondents strongly agreed that there were no incentives to spur them on to teach Physical Science.

#### *Support*

|   |                                                                               |      |      |      |             |             |             |
|---|-------------------------------------------------------------------------------|------|------|------|-------------|-------------|-------------|
| 1 | The support from the school administration is poor.                           | 2.15 | .701 | 13.7 | <b>61.3</b> | 20.8        | 4.2         |
| 2 | The support from the science department is poor.                              | 1.19 | .691 | 24.4 | <b>64.3</b> | 7.1         | 4.2         |
| 3 | There is no recruitment policy/strategy for the teachers of Physical Science. | 3.25 | .782 | 3.0  | 11.9        | 41.7        | <b>43.5</b> |
| 4 | There is no retention policy/strategy for the teachers of Physical Science.   | 3.25 | .829 | 2.4  | 11.9        | <b>47.0</b> | 42.3        |
| 5 | The lack of Physical Science teaching resources                               | 2.64 | .762 | 8.3  | 33.9        | <b>43.3</b> | 14.3        |
| 6 | Support from the District managers is lacking.                                | 2.41 | .707 | 10.8 | <b>43.7</b> | 39.5        | 6.0         |

The support and rewards given to teachers, as achievement stimulants (Scheerens' 1990 model), are provided by, among others, the government, administrators and the inspectorate. Gold (2006) cited poor support from the administration as one of the reasons for the shortage of Physical Science teachers. The respondents strongly disagreed or disagreed that there is poor support from the school administration (75%) and the District managers (54.5%). This means that the administration and District management support them during the teaching and learning processes. They also strongly disagreed or disagreed (88.7%) that there was poor support from the Science department. This implies that the Science department supports teachers with policy documents, for example, teaching resources. The policy pronouncements on recruitment and retention are encapsulated in the inputs in Howie's (2006) model. There was agreement among the respondents that policy documents do not contain pronouncements stipulating how they should be recruited (85.2%) and retained (89.3%). This should be the government's priority, since the majority of the officers in the Department of Education have raised their concern on the shortage, and there is nothing tangible that has been done, especially for Physical Science teachers.

#### *Subject Content*

|   |                                                                      |      |      |      |             |             |             |
|---|----------------------------------------------------------------------|------|------|------|-------------|-------------|-------------|
| 1 | Physical Science requires a strong mathematical background.          | 3.37 | .686 | 1.2  | 9.6         | 40.1        | <b>49.1</b> |
| 2 | The content of Physical Science is not easy to teach.                | 2.26 | .712 | 9.5  | <b>58.9</b> | 27.4        | 4.2         |
| 3 | Physics has more abstract concepts.                                  | 2.59 | .889 | 7.1  | 32.7        | <b>54.2</b> | 6.0         |
| 4 | The Physical Science content makes use of males in its examples.     | 2.15 | .654 | 26.8 | <b>36.9</b> | 30.4        | 6.0         |
| 5 | Tertiary students lack knowledge of the content of Physical Science. | 2.38 | .729 | 7.7  | <b>48.8</b> | 41.7        | 1.8         |
| 6 | The Physical Science curriculum at universities is sub-standard.     | 2.28 | .727 | 12.0 | <b>51.8</b> | 31.9        | 4.2         |

The subject content is part of the processes in Howie's (2003) and Scheerens' (1990) models, and school climate in Craig and Heneveld (1996) model. The Physical Science content involves the manipulation of numerical data, thus the need for a strong Mathematics background for learners who intend pursuing Physics Science courses at tertiary level, and this is supported by the majority of the respondents (89.2%). The majority of the respondents noted that the Physical Science content contains more abstract concepts than the other sciences (60.2%), but at the same time, it is not difficult to teach (68.4%). They strongly disagreed or agreed that the Physics Science content uses males only in its examples (63.7%), that the learners lack knowledge of the Physical Science content (56.5%) and that the university curriculum is sub-standard (63.8%).

Table 1: Contd...

| S. No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | The shortage of Physical Science teachers is due to the following factors:   | Mean | Std. dev. | SD1  | D2          | A3          | SA4  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|------|-----------|------|-------------|-------------|------|
| <i>Motivation</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                              |      |           |      |             |             |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | There are few Physical Science role-models.                                  | 3.07 | .677      | 4.2  | 10.7        | <b>59.5</b> | 25.6 |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Physical Science is boring to teach.                                         | 1.64 | .749      | 44.6 | <b>48.8</b> | 4.2         | 2.4  |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | The Physical Science teachers do not inspire the learners.                   | 2.09 | .641      | 20.2 | <b>54.2</b> | 22.0        | 3.6  |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Demoralising poor initial Physical Science experiences.                      | 2.60 | .768      | 3.0  | 39.5        | <b>52.1</b> | 5.4  |
| <p>Motivation, according to the Scheerens (1990) model, is an achievement stimulant which can take on different forms, and is an essential attribute to spur learners to put in more effort in the acquisition of Physical Science content. The Cornell University (2011) noted that the learners are likely to be dissuaded to pursue a career in Physical Science due to poor initial experiences. The majority of the respondents strongly agreed or agreed (85.1%) that there are but a few Physical Science role-models who could motivate the learners, together with exposure to demoralising poor initial Physics Science experiences (57.5%). The respondents strongly disagreed or disagreed that Physical Science is boring to teach (93.4%), and that the teachers do not inspire the learners to learn Physics Science (74.2%). Thus, the teachers are motivated and enjoy teaching Physical Science, which is manifested in the active participation of the learners in the subject or learning area. It is unclear what aspect in the teaching and learning processes motivates them, since in the same section on teacher challenges they argue that they are demotivated.</p>                                                                                                                                                                                                                              |                                                                              |      |           |      |             |             |      |
| <i>Attitudes</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                              |      |           |      |             |             |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | The world of Physical Science is portrayed as a man's world.                 | 2.95 | .919      | 6.0  | 14.3        | <b>58.9</b> | 20.8 |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Teaching lacks prestige.                                                     | 2.80 | .815      | 8.9  | 27.4        | <b>38.7</b> | 25.0 |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | The lack of respect for teachers among the learners.                         | 2.24 | .769      | 17.3 | <b>47.6</b> | 28.6        | 6.5  |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | The lack of respect for teachers among the administrators.                   | 2.11 | .791      | 19.6 | <b>54.2</b> | 21.4        | 4.8  |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | The learners have a negative attitude towards Physical Science               | 3.08 | .773      | 4.8  | 13.2        | <b>51.5</b> | 30.5 |
| <p>Issues on attitude have been classified as 'outputs' by Howie (2006) in the school effectiveness model. Some students do not pursue Physical Science programmes at tertiary level because of the attitude they have towards the subject, which may be rooted in their initial experiences with the subject or the teachers. The majority of the respondents strongly agreed or agreed (79.7%) that Physical Science is portrayed as belonging to a man's world. This could be one of the reasons that contribute to the few numbers of female Physical Science teachers. The opinions of the respondents who strongly agreed or agreed with the view that some learners have a negative attitude towards Physical Science (82%) and that teaching lacks prestige (63.7%) can be regarded as part of the factors contributing to the shortage of Physical Science teachers. The majority of the respondents strongly disagreed or disagreed that there is lack of respect for teachers among the administrators (73.8%) and that there existed a lack of respect for teachers among the learners (64.9%). Thus, the Physical Science teachers are accorded the appropriate respect by both the learners and the administration. Murphy and Whitelegg (2006) argue that learners must be motivated to cultivate the right attitude towards Physical Science so that they could realise its significance later in life.</p> |                                                                              |      |           |      |             |             |      |
| <i>Professional Development</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                              |      |           |      |             |             |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Too few Physical Science courses at tertiary level to attract more learners. | 2.81 | .768      | 4.2  | 28.6        | <b>49.4</b> | 17.9 |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | The drop-out rate in transition from high school to university is high.      | 2.85 | .734      | 3.0  | 28.9        | <b>48.2</b> | 19.9 |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | There are very few training institutions for Physical Science teachers.      | 3.08 | .783      | 4.2  | 10.7        | <b>58.3</b> | 26.8 |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Rigid entry requirements for Physical Science education at tertiary level.   | 2.90 | .852      | 4.8  | 21.4        | <b>52.4</b> | 21.4 |
| <p>Issues on attitude have been classified as 'outputs' by Howie (2006) in the school effectiveness model. Some students do not pursue Physical Science programmes at tertiary level because of the attitude they have towards the subject, which may be rooted in their initial experiences with the subject or the teachers. The majority of the respondents strongly agreed or agreed (79.7%) that Physical Science is portrayed as belonging to a man's world. This could be one of the reasons that contribute to the few numbers of female Physical Science teachers. The opinions of the respondents who strongly agreed or agreed with the view that some learners have a negative attitude towards Physical Science (82%) and that teaching lacks prestige (63.7%) can be regarded as part of the factors contributing to the shortage of Physical Science teachers. The majority</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                              |      |           |      |             |             |      |





the teachers with attractive salaries and allowances. In order for the teachers to be abreast with issues pertaining to their discipline, there is a need for the DHET and other institutions to provide them with professional development by means of workshops, further training, weekend and evening classes, paying the teachers' subscription fees to research organisations and engaging them in research projects and monitor graduates in the field of Physical Science or teaching profession.

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