

Foundation Provision: Any Difference in Student's Performance?

B M Sondezi-Mhlungu; P Molefe

Physics Department, University of Johannesburg, P.O. Box 524, Auckland Park,
2006, South Africa

E-mail: bmhlungu@uj.ac.za

Abstract. Science, Engineering and Technology (SET) have become essential in the development of the country in all its facets. It has been observed over the past few years that students entering university for degree studies in their respective fields experience considerable level of difficulty. Inadequate understanding of basic mathematics and physics concepts has been identified as a critical deficiency characterizing the performance of SET first year students. As a norm, the intake is usually based on Grade 12 results. Admission to mainstream (three year) programme or a four year extended programme is determined on the basis of M-Scores by various respective institutions. Analysis of students' performance in the four year programme at the University of Johannesburg painted a bleak picture and this led to the introduction of the Foundation Provision Programme (FPF) as a precursor to the normal first year curriculum. This programme serves to adequately develop the basic or foundational competencies necessary for students to embark on successful first year physics studies and beyond. The sample in this study comprised a group of freshmen from Grade 12 registered for various degrees in Science, Engineering and Optometry. All these groups receive physics tuition in one lecture class. The Foundation Provision Programme was implemented for the first time at the University of Johannesburg in 2010 and the results obtained were compared to the results of students' performance obtained from previous years.

1. Introduction

Different institutions of higher learning have different criteria of accepting students into their system of learning. Although an M-score has been a standard norm, but in some institutions, over and above that, some tests are written by the students before they can be admitted into the institutions for their respective degrees. These tests have been used as a means of screening the students and thereby providing the faculty/departments with the information as to whether the students can be admitted to the course or not. In many institutions the culture of writing aptitude tests is fading and the students are solely admitted based on their grade 12 results. In the past few years (from 2005) it turned out that the results obtained by the students in grade 12 were not necessarily a true reflection of the students' abilities in their first university experience. These were not the necessary tools that could predict the students' performance especially in their physics lectures. Different approaches in trying to help the students cope with the amount of work to be conceptualized and applied thereof have been employed over the years. In 2005 the University of Johannesburg (UJ) introduced SET programme (Science,

Engineering and Technology) in order to give the proper background in Maths, Applied Maths, Physics and Chemistry needed by the students (BSc., Engineering and Optometry) to undertake their respective degrees. This was introduced to address the needs of the students who had poor Maths and Science background as reflected from their grade 12 results. Students would do their first year of SET programme and then be transferred into the first year mainstream degree during their second year of university experience. As the curriculum has been continually re-visited; an extended degree was introduced in 2007 whereby the normal three-year degree was extended into four year, splitting the first year of the curriculum into two years with the aim of helping the simulation process of the physics concepts more effective. This has been an exercise full of unexpected results since the performance did not improve as predicted. A number of problem areas were identified, and that led to an introduction of Foundation Provision Programme (FPP) in 2010. Although the first year syllabus was still going to be done over two years, the student's performance at the end of the year was not satisfactory. After the results obtained at the end of 2009; it was decided that FPP will be introduced. In 2010 FPP was introduced; that is, the first term of the year was dedicated to basic mathematics concepts, as these were identified as problem areas for most of the students coming fresh from high school in these past few years. In 2011 intensity in the level of giving FPP was increased in terms of time spent in this module, time allocated increased from a term to a semester. This paper presents the observations and analysis of the physics students' performance after being taken through this programme.

2. Methodology

Students enrolled for any of the extended degree (BSc., BIng., BOptom) having Physics as one of the courses were taught in one class, that is, no special groupings as per degree registered by the student was done. Foundation Provision, which comprises of basic maths, (FOIL rule, BODMAS rule, Fractions, Brackets, Linear and quadratic equations, Straight line graphs, Simultaneous equations, Limits, Basic Trigonometry), vectors and forces was done prior to starting with first year syllabus and other physics topics such as, motion in one and two dimension, forces and Newton's laws of motion, work and energy, impulse and momentum, waves and sound and the basics of electricity.

3. Results

After a lot of changes that has occurred in different sectors in South Africa, including some noticeable changes in education system, a first group of students under a new system, National Senior Certificate (NSC) matriculated in the year 2008. This is the group that was accepted in higher institutions of education in 2009. University of Johannesburg (UJ) also had lots of students who registered after passing their grade 12. The performance of this group in their first year physics was of great interest and the results are shown in figure 1 below. The figure shows a histogram of number of students (in percentage, %) versus the students' performance (%). It is shown that a number of students did not perform well, where a reasonable number of students failed their mid-year exam, obtaining marks between 0 and 39 %. It was observed that the trend of these results carried on to the end-year results (not shown; to be published somewhere else). This huge number of failures (more than 71 %) raised concerns within the department of physics and in the faculty as well. It called for the drastic intervention plans that would remedy the problem at hand. A Gaussian fit (solid line in the figure) according to the expression:

$$y = a \exp^{-0.5(x-\bar{x}/b)}$$

where a is the maximum number of students that obtained an average mark, \bar{x} is the average mark of the entire students and b is the parameter that indicates the goodness of fit. FPP was implemented

for the first time at UJ in 2009. The performance of students after the first semester was also observed and analysed. Similarly, the trend was observed and the results are plotted below.

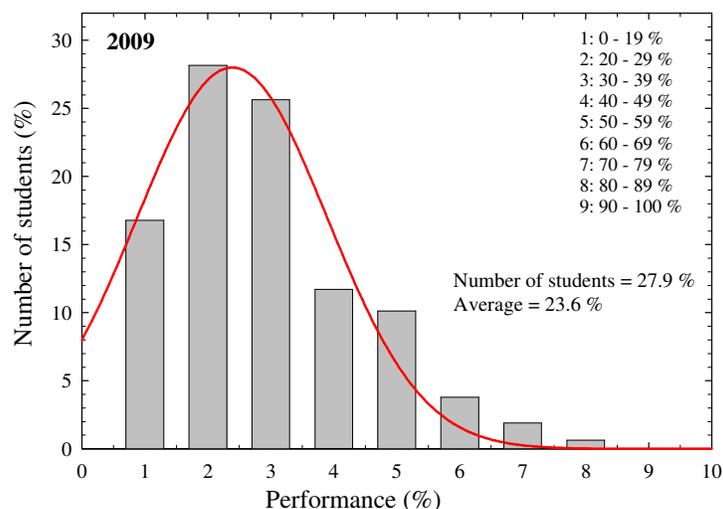


Figure 1: The histogram indicating the performance of students after they wrote their mid-year exam in 2009

Figure 1 above shows that the 2009 cohort performance achievements were very low; this is ascribed to the grade 12 examination that had confusion in relation to the standard of the grade 12 paper written. Most of the students failed their mid year exam, this implied that they were not ready or there were gaps in their content knowledge of physics.

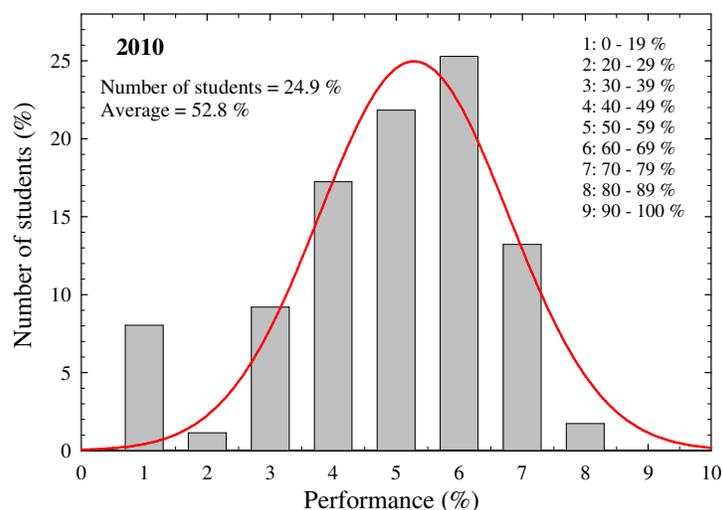


Figure 2. The histogram showing the performance of students after they wrote their mid-year exam in 2010

The year 2010 and 2011 cohorts had shown an improvement of result with 24.9% and 36.3% of the students achieving an average of 52.8% and 51.8% (shown in figure 2 & 3) respectively and compared

to an average of 23.6% in 2009 cohort. This can be ascribed to the introduction of FPP that was taught in the first term. From this outcome, it is evident that the introduction FPP played an important role in improving the results.

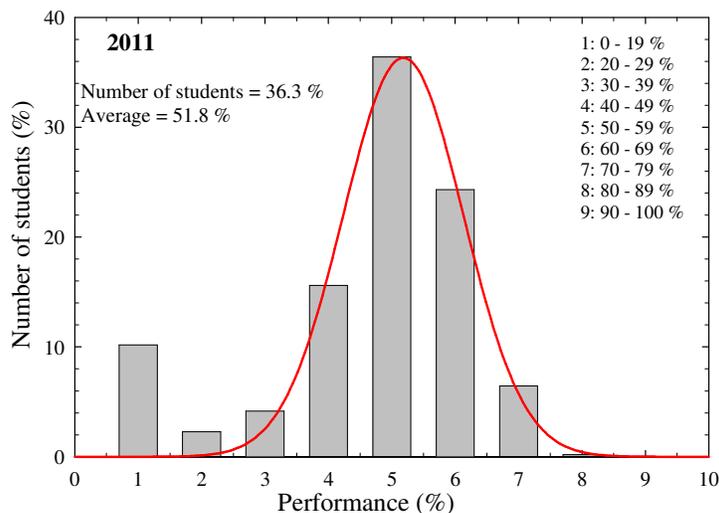


Figure 3: The histogram showing the performance of students after they wrote their mid-year exam in 2011

Table 1: A table of selected questions used for the survey.

Question	Question Phrasing
Q1	How well did your experiences in grade 12 Physics and Mathematics prepare you for this module? Make a cross (X) on the relevant box.
Q4	Are there any areas of PHY1A1E in which you had to “unlearn” concepts you had previously learnt at high school? _____. If so, please specify the concept(s).
Q6	Are there any areas of PHY1A1E that repeated material that you had already thoroughly mastered at high school? _____. If so, please elaborate.
Q7	Was the introduction of Basic Mathematics helpful in understanding the Physics topics studied in this module? Make a cross (X) on the relevant box.

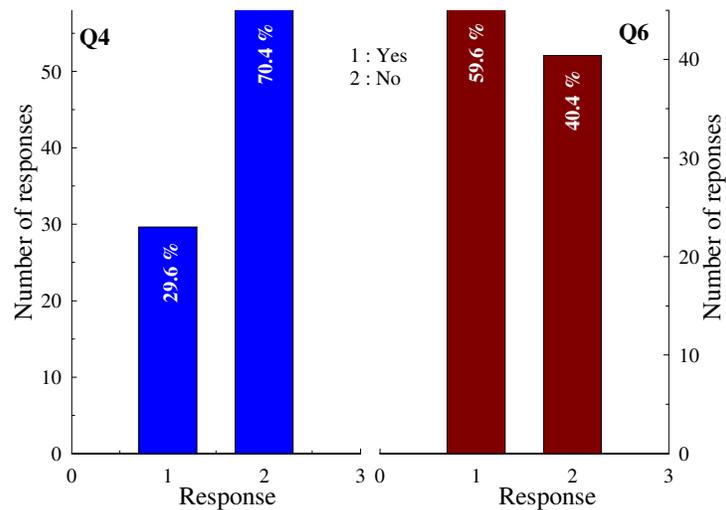


Figure 4: The histograms showing the responses of students for question 4 and 6.

When interpreting the questionnaire given to students in their 10th week of the first semester in relation to their preparedness from their high school physics subject for NSC, the responses received were considered possible indicators of likelihood to succeed in their first year of foundation physics. Q4 responses highlighted that the foundation provision programme helped 29.6% of students to correct the misconceptions they had from high school. 59.6% of students (as shown by Q6 of figure 4) indicated that most of the concepts taught in the first term had already been thoroughly mastered at high school. This is confirmed by their 2011 mid-year results where an average of 51% was achieved.

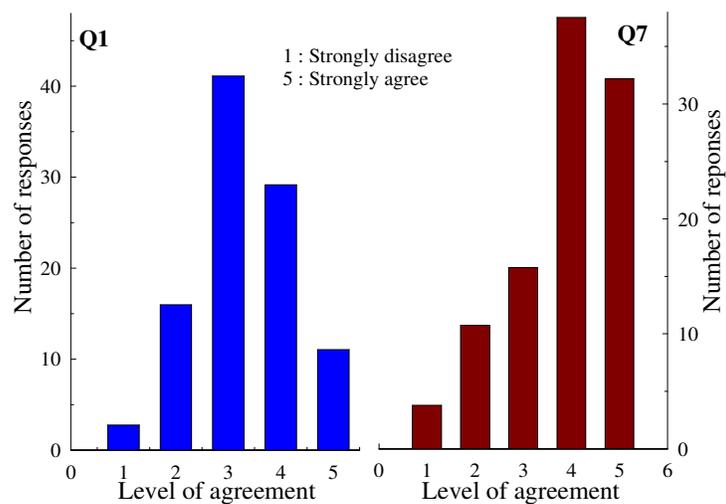


Figure 5: The histograms showing the responses of students for question 1 and 7.

Reasonable number of students (more than 80 % of students) indicated that their high school mathematics and physical science prepared them well to study foundation physics, see figure 5 (Q1) Putting this response with that obtained from Q7, where students implied that FPP helped them to understand the basic physics that they need to study physics 1 is supported by their results June 2011 exam results.

4. Conclusion

The observation at hand indicates a great improvement in students' performance due to the introduction of Foundation Provision Programme. Further analysis is ongoing as to establish the reasons behind the constant average mark of the 2010 and 2011 cohorts, despite the difference in time spent in FPP 2010 and FPP 2011.

5. Acknowledgements

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