Why do we lose undergraduate physics students?

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The situation in physics teaching and issues such as physics students' tertiary enrolment, attrition, persistence, attainment and rates of return to society is a matter of concern. One University in Ethiopia was used as case study to identify the salient attrition and retention factors associated with physics students with the purpose to propose a framework for student retention. Two rounds of the Delphi survey of academic managers, physics department staff members and science education researchers were employed. The first round focused primarily on the first objective (determining reasons of student attrition) and the second objective (how best to respond to student attrition). Three basic themes, namely: (i) *cognitive attributes*; (ii) *institutional/departmental attributes* and (iii) *social interaction attributes* were identified as salient attrition factors associated with the physics students along with possible reasons rated by participant expertise as high (mean score greater than 3.17). Department-wide retention theoretical constructs, namely: (i) *student admission and placement*; (ii) *academic facilities*; and (iii) p*hysics curriculum and instruction* were explored as framework that fits the needs of the students and institution. These indentified theoretical constructs could be informative to universities worldwide which can support academic managers optimize the implementation of an institutional-wide student retention framework.

Introduction

Almost all technology today is based on scientific principles and therefore a science literate populace is recognized as being better prepared to contribute to sustainable economic development (Ware, 1992). In his article, published in *Physics Today*, Zingu (2004) emphasized that "the participation rate in science education at secondary school level is a key indicator of a country's potential for producing a scientifically literate society, which in turn, is a prerequisite for the development of a physics tradition and technological and economic advancement" (p 46) Countries in Africa have gross enrolment rates in science between 5% and 10% (Zingu, 2005). It is therefore not surprising, that Zingu argues, "the development of a physics tradition, and the corresponding public investment in physics in those countries, is limited, or even nonexistent" (p 37). The challenge is to improve the enrolment rate in undergraduate physics in a way that is meaningful and substantial to develop the capacity of physics graduates and finally to foster physics in developing countries.

Reason for study

The manner in which science students are admitted for tertiary education as well as the issues of science and mathematics students' enrolment, persistence, progress, attrition, attainment and rates of return to society have become a matter of increasing public controversy. The retention and attrition of students is a very complex issue. Numerous studies on university attrition have suggested a wide array of reasons why students fail to complete undergraduate programs (Smith & Naylor, 2001; Barefoot, 2004; Tinto, 1975). However, there is not much literature available on attrition and retaining students in the sciences, and even less is directed towards what affects retention within a specific university physics program (Slavin, 2008). For example, according to Slavin (2008), "a search under 'retention' in the *American Journal of Physics* turned up only two articles that referred to the retention of physics students, while

a search under ‘dropout’ gave no results” (p 840). The purpose of this study is therefore to investigate the problem areas with regard to student retention.

The Delphi Technique: a research design

The Delphi method is a commonly used technique for gathering data from participants within their field of expertise. It is created as a group communication process which seeks to achieve a convergence of opinion on specific practical issues. The Delphi technique has been used in various fields of study such as needs assessment, policy determination, program planning and resource utilization to design a range of alternatives, explore underlying assumptions; along with correlate judgments on issues spanning a wide range of topics (Hsu and Sandford, 2007). According to this study, the technique is appropriate as a method for consensus-building by using a series of questionnaires using two or more iterations to collect data from a panel of selected participants. That means, the technique is a structured communication process during which a series of questions are posed to determine the opinion of classified experts.

Sample

One University in Ethiopia was used as case study to identify the salient attrition and retention factors associated with physics students. Two rounds of the Delphi survey of academic managers, physics department staff members and science education researchers were employed.

Data collection

Data from the questionnaires were recorded in matrices under the following two categories; reasons for student attrition, ***‘problem-focused’*** text data and basic strategies for enhancing student retention, ***‘solution-focused’*** text data. The first category was ***‘problem-focused’*** data, representing constraints to student retention (reasons for student attrition); the answers to the sections on causes of student attrition, institutional causes, departmental factors and cognitive and social constraints of student attrition and other factors. The second category ***was ‘solution-focused’*** data, which included the answers to the sections asking for success factors and better strategies at the institutional, particularly physics department, level cited by panellists.

Findings

The relevant and repeated responses on both the categories comprised a list of many statements which were then translated into a set of generic themes of statements and further screened to avoid duplication. The final synthesized list of statements under each theme represented major factors for student attrition and potential student retention strategies suggested amongst all panellists in round one, and formed the basis for Questionnaire Two. In the case of ‘problem-focused’ data, themes were organized into (i) *cognitive attributes*; (ii) *institutional/departmental attributes* and (iii) *social interaction attributes*. In the case of ‘*solution-focused*’ data, themes were organized into three main areas which will be referred to as theoretical constructs and labelled as Theoretical Construct I (*Student Admission and Placement*), Theoretical Construct II (*Academic Facilities*) and Theoretical Construct III (*Physics Curriculum and Instruction*)

Conclusion

The findings of this research have many implications for the academic managers of higher education institutions, department heads, deans and all academic managers. This will be discussed in detail during the presentation.

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