Towards a Theoretical Model to Investigate the Impact of Laboratory Work in the Teaching of Cell Biology

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Presentation outline

• Introduction
• Research objectives
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Introduction (1)

- Despite the conviction that laboratory work plays a central role in the teaching of natural sciences and development of scientific literacy at all levels of the educational system, several authors still concerned about its effectiveness and contribution to the performance of students (Cossa & Uamusse, 2015; Ferreira & Morais, 2013; Danmone, 2012; Hofstein & Mamlok-Naaman, 2007; Al-Naqbi & Tairab, 2005).

- A number of factors considered as hampering the effective implementations of laboratory work are associated to the lack of:
  - adequate conditions and availability of equipment and laboratory materials including financial resources (Cossa, 2007; Bekalo & Welford, 1999; Hodson, 1992).
  - qualified teachers and large number of activities that teachers are required by new the curricula (Ogunniyi, 1986; Mothabane, 2013).

Introduction (2)

- Like in many developing countries, in Mozambique, laboratory work fails because (Cossa & Uamusse, 2015; Allsop, 1991):
  - many science teachers, in their initial training, are not adequately prepared in terms of practical skills to use laboratory work as a means of instruction.
  - in their activities plan, the time devoted to science and conduct experiments is not enough.
  - in the system of examination the focus is on the theory in detriment to practical activities.

- At Eduardo Mondlane University, beside the constraints already described, laboratory classes still be conducted by means of a written practical guide considered in the literature as ‘laboratory cookbook’ or ‘recipe-style laboratory’.
Introduction (3)

- Several authors criticize the use of a ‘recipe-style laboratory’ by the following reasons (Johnston & Wham, 1982; Solomon, 1988; Hodson, 1996; Cossa, 2007; Woodley, 2009):
  
  - Students are only required to follow a set of steps to demonstrate and verify the scientific concepts already known;
  
  - Students do not have opportunity to apply scientific knowledge, develop understanding and skills of the phenomenon under study; and
  
  - Inadequate to assess students’ skills in manipulating laboratorial equipment, carrying out observations and investigations during laboratory classes.

Possible Framework at EMU for developing laboratory work (Langa et al., 1996)
Objective and Methodology

❖ Research objective
➢ Conduct a reflection on the feasibility of a theoretical model designed with the purpose of evaluating the extent to which the objectives of the laboratory work in cell biology course are achieved.

❖ Methodology
Consisted of 3 steps:
I. Reviewing the literature to gain a better understanding of the role of laboratory work in the teaching and learning of natural sciences;
II. Analyzing the current situation of the laboratory work at EMU with particular reference to the Department of Biological Sciences; and
III. Based on the teachers and learners’ perceptions, conduct a reflection on the pedagogical implications of the designed theoretical model.

The Designed Theoretical Model
Adapted from Easton (1996)
Results of study (1)  
Pedagogical implications of the theoretical model

❖ Despite the prevalence of unsatisfactory conditions to effectively implement laboratory work, teachers and students share a common understanding that the laboratory work is fundamental to teach and learn cell biology content indicating that it helps in the:
  ➢ acquisition of scientific knowledge;
  ➢ development of practical and investigation skills; and
  ➢ development of positive attitudes toward science subjects.

❖ Teachers indicated that the adoption of a constructivist approach would provide the students with ample opportunity to interact with one another and with learning materials.

❖ Teachers and students agreed in their opinions that there is need to determine the students’ level of knowledge and skills before being subjected to new learning materials or equipment (inputs).

Results of the study (2)  
Pedagogical implications of the theoretical model

❖ Taking into account the heterogeneous level of knowledge and skills demonstrated by most of the students attending the cell biology course, there is a feeling that adopting new teaching approaches would provide the students with more opportunities to build their own knowledge through laboratory work. For instance,
  ➢ constructivist approach to facilitate student-student interaction;
  ➢ incorporation of discovery-based laboratory activities to minimize the limitation of financial and material resources;
  ➢ use of different types of laboratory work to engage students in the development of their own knowledge and promote meaningful learning;
  ➢ link between the objectives and different types of laboratory work to minimize the misinterpretation of the functions of laboratory work.
Conclusions (1)

- The designed theoretical model seems to assist in evaluating the impact of laboratory work in the teaching and learning of cell Biology.

- The model allowed to identify and interpret some of the factors that can positively or negatively influence the effective implementation of laboratory work in cell Biology.

- A particular feature and useful in applying this model is evidenced by the fact that both teachers and students stressed the need of during the design of laboratory work a greater attention should be paid to the characteristics of the students taking into account their level of knowledge and skills before being subjected to new materials and equipment, that is, the initial condition (inputs).

Conclusions (2)

- The model helped to understand the context in which laboratory classes are performed as a key element since this can influence the way teacher plans or prepares laboratory activities; articulates with the students, head of the Department and/or course Director.

- The context can also determine how students interact with the teacher during laboratory classes in order to engage them actively in building their own knowledge.

- The validation of the practicality of the designed theoretical model requires that a linkage between the various elements or factors be established.

  - Only in that way can help to delineate clearly the constraints that might challenge the achievement of the expected laboratory work objectives in the cell Biology course.
References


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Merci Beaucoup
Thank you