MAURITIUS RESEARCH COUNCIL

La Maison de Carné, Royal Road, Rose Hill.

Tel: (230) 465 1235 Fax: (230) 465 1239
E-mail: mrc@intnet.mu Website: www.mrc.org.mu

MRC Unsolicited Research Grant Scheme:

Investigating the Common Core Constructs in Student's Acquisition of Logico-Mathematical Concept in Physics at HSC Level

Mr V K P Parmessur, Dr Y Ramma, Dr A Ramdinny and Dr H Bessoondyal

EXECUTIVE SUMMARY

This research study aimed at:

(i) Determining the state of physics teaching with respect to conceptual difficulty in understanding of abstract concepts,

(ii) Investigating the degree of awareness of logico-mathematical concepts in physics from the teachers' and students' perspectives,

(iii) Investigating and addressing students' logical problem solving skills.

Methodology:

The approach adopted was that of action research which involved the teaching of physics concepts using an interactive pedagogy, incorporating core-constructs. Prior to adopting the new pedagogy, developed by the research team, it was necessary to investigate to what extent interactions were taking place in the classroom and the type of strategies that were being used by the teachers in ten pilot schools.

The groundwork has been set by the following methodological approaches:

(i) an in-depth analysis of the mathematics and physics curricula with a view to identifying the common core constructs and the degree of interdependence,

(ii) observation of physics classes to determine whether the teaching takes account of core constructs and the degree of usage,

(iii) five structured individual interviews of physics teachers,

(iv) six unstructured group interviews of 100 students,

(v) administering of questionnaires to five teachers and 300 students,

(vi) conducting physics classes in 5 schools using core constructs,

(vii) evaluation of lessons.

Brief Introduction:

It is a common fact that mathematics forms the basis of physics and it is also a known fact that physics is considered as one of the most difficult subjects in the school curriculum. A number of research studies carried out in the local or international contexts do confirm that many students are not able to bridge the gap between mathematics concepts and physics1[1]. The construction of purposeful knowledge becomes difficult and meaningful learning is hampered. Teachers have a very important role to play in enabling students to link mathematics with physics in a systematic process whereby students' pre-conceptions of concepts are logically examined. It is imperative that the teaching of physics does not concentrate on the body of knowledge but on development of process skills.

This research examines the process of teaching and learning and the development of cognitive skills of learners using an innovative strategy which incorporates core-constructs and cognitive dissonance.

The Findings:

The teaching of physics is 'dry'.

The teaching of physics has not changed at all; it is carried out in a stereotyped manner with emphasis on the transmission of knowledge rather on the development of process skills which requires students to be engaged in a state of cognitive dissonance.

Theory classes are not linked with practical work.

The teaching of concepts is done in isolation of the practical aspect of that concept. Science is a practical subject and students should be give the opportunity to visualize a number of processes to be able to develop understanding of the concept. Otherwise, students will resort to rote memorization to learn.

Prior knowledge is merely tested at the beginning of a lesson.

Any lesson should start by testing pre-existing ideas of students, which are related to the concept. In this way, the teacher will be able to further guide students during the lesson development. Unfortunately, only 'knowledge' type questions are asked which will not determine to what extent students are prepared to develop understanding of the concept that would be taught.

There is almost no interaction between teachers and students.

Since emphasis is on transmission of knowledge, students' understanding of the concepts is not probed into through questioning. The very few questions that are asked are closed type questions which deal with 'knowledge' and 'understanding' of the Bloom's Taxonomy. This 'one way traffic' type lesson promotes rote learning and jeopardizes the development of cognitive structures. Interaction between teachers and students is important for the students to develop conceptual understanding of the lessons.

---

[1] Roth. W-M, Roychoudhury, A (2003), "Physics students' epistemologies and views about knowing and learning", *Journal of Research in Science Teaching*, Vol. 40, supplement, pp. S114-S139

Links between mathematics and physics are not developed in the physics lessons.

The teaching of physics is carried out with the assumption that students have the mathematical pre-requisites to understand the associated physics concepts. Unfortunately, our research study has shown that this is not the case and students still experience difficulty to interpret the mathematical knowledge which is directly related with the physics. Teachers are expected to guide students to make the linkages between mathematics and physics with a view to facilitating the development of core-constructs.

Teaching using core-constructs

Core construct is a process of coherence and association related to the process of schematic learning. During the teaching of the lesson, it was at no time assumed that students will understand the mathematical relationship of concepts in physics. Students' level of understanding was gradually tested using open questioning and through a systematic process which incorporates cognitive dissonance. Most of the time, students by themselves came up with the formulation of ideas through a series of prompts.

Evaluation:

The evaluation of each lesson was carried out by means of a questionnaire intentionally developed for that purpose. The setting up of the questionnaire was devised to determine the level of appreciation of the students after the lessons were taught. The students were very enthusiastic about the lessons and acknowledged their appreciation of the lessons.

Conclusion:

This research study has enabled the researchers to identify various problems in the teaching and learning processes, more specifically the types of problems students encounter during physics lessons. The traditional way of teaching physics is still persistent in many schools and this is encouraging rote memorization of lessons; deep learning does not seem to take place.

The use of core-constructs in teaching and learning of physics takes into consideration the existing level of acquisition of mathematics and physics concepts by learners. The pedagogy adopted gradually challenges pre-existing knowledge of learners by inducing cognitive dissonance in their intellect. Learners can then construct purposeful knowledge.

The findings clearly indicate that the effective teaching of physics would require teachers to create the relevant linkages with core mathematics concepts in the first instance and the core concepts in other disciplines as well.

Students will thus be able to develop a holistic understanding of concepts and their interrelationships and use the knowledge acquired at school to solve complex problems in real life situations.