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Development of Science and Mathematics Curriculum Modules for the 21st Century: The Pedagogical Implications

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This research study, the Development of Science and Mathematics Curriculum Modules for the 21st Century, or Project SC21 for short, involves the study of the significant pedagogical implications for curriculum development in Singapore. There are five teams working within the ambit of Project SC21, with each team involved in the development and implementation of different curriculum materials for schools or junior colleges. At the same time the teams are studying the efficacy and feasibility of introducing these materials into the syllabus.

Using an emergent research design, a number of research questions evolved as being pedagogically important for curriculum development and implementation, and these in turn led to some of the findings that are emerging from the study. An eclectic approach using different methods was employed to obtain the necessary data to address the research questions, and these included observation notes, artifacts, field notes, dialogue sessions, teacher and student questionnaires. Together they provided a rich source of detailed information about what went on in the classroom, the impact of the modules on student learning, and the extent to which the students were empowered in their own learning.

To increase the trustworthiness of these research data, all the research questions were examined by more than one technique to provide for validation of the findings through triangulation. The triangulation process also maximised the probability that the emergent assertions/findings were consistent with the variety of data sources, thus increasing their reliability. As a way of conceptualising and conveying the outcomes from the multiple data sources, the data base was organised into clusters of major assertions. The following are some of the assertions that are emerging from the study.

ASSERTION 1

Teacher beliefs and the overhang of examinations

exert a strong influence on classroom practices.

ASSERTION 2

The hands-on practical nature of curriculum materials facilitates commitment by teachers to a shift of orientation from transmission to transaction.

ASSERTION 3

The active engagement by students in the hands-on practical sessions is a major indicator of student learning.

Several of our findings from this study have implications for curricular reform efforts. Firstly, intended changes in teacher actions need to take into account not only the intended behaviours of teachers, but also the existing beliefs which legitimize those behaviours. When teacher beliefs are incongruent with requirements imposed externally, they can act as restraints to change. Secondly, changes in classroom practices by teachers can be expected either through a personal commitment to change, or through the mediation of the actions of others, such as their students. In this study this was seen in the winning over of teachers to the pedagogical advantages of moving away from the transmission-oriented approach to teaching and learning. The high level of student involvement and interaction during the study was something the teachers saw for themselves. They were thus able to see the need for them to shift towards a transaction-oriented approach. This is particularly significant for those teachers who had taught for more than two decades using the transmission mode, but are now prepared to make a switch to the transaction mode of teaching.

This study shows that a transaction-oriented approach with attendant empowerment of students to take charge of their learning, is superior to the transmission-oriented approach. The former often provides a teaching-learning situation which is more enduring than the latter. This study has also shown that the best way to help students to see and talk in the ways of the scientific commu-

nity is by engaging them, through empowering them, in the practice of its activities.

Of particular concern emerging from the study are two observations:-

1. with a tight time frame to observe, teachers are becoming increasingly intolerant of digression;
2. building understanding becomes less of a concern than covering content and preparing for success in examinations.



[For a more detailed report on this study, readers may wish to refer to Toh et al. (in press) *Developing Curriculum in Singapore: Teacher-Academic Partnerships. Journal of Curriculum Studies.*]

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