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Science Education Research which Matters

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Outline

- Impact of Educational research
- Assessment reform in science education in Hong Kong
- Three projects related to science assessment
- Impact of research and research which results in impact

http://www.mfiles.co.uk/mp3-files.htm

Impact of Education Reforms

- Reform do not take into account what happens in the classroom.
- Agitation on the surface of the water, but ocean floor is calm and serene

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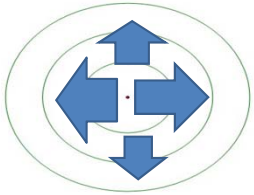
Reasons for lack of impact

- Failed improvement (Harris & Christpeels, 2008)
- Too fast imposed
- From top or outside of school
- Insufficient capacity building
- Implementation difficulties underestimated.

Impact of research

- Given the different possibilities, how should research look like in reality
- How to address the different levels of impact?
- Are there levels of impact which are particularly relevant to education reform initiatives?



Assessment reform in HK – secondary science

- Education reform was launched in 2001 (Education Commission, 2000),
- Reminding teachers that public examinations cannot evaluate a student's overall abilities
- (Education and Manpower Bureau, 2004), major changes in assessment are likely to occur
- Assessment procedures should address the range of valued learning outcomes and not just those that are assessable through external written examinations

Education Commission (2000) *Reform Proposals for the Education System in Hong Kong.* Hong Kong Special Administrative Region of the People's Republic of China: Printing Department.

Education and Manpower Bureau (2004) *Reforming the academic structure for senior secondary education and higher education – Actions for investing in the future.* Retrieved November 8, 2004, from http://www.emb.gov.hk/index.aspx?langno=1&nodeID=3998.

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- School-based assessment tasks which are exemplified as research projects, products/ models, a practical activity or experiment, or a performance, and adopt a wider range of approaches to assessment which are to be standards-referenced
- Between 20-30% of the total assessment for each subject at senior secondary level

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Science teachers interpret these changes as …

- An emphasis on the implementation of scientific investigation projects
- The senior secondary curriculum is very crowded, most of them conduct such projects at the junior secondary levels
- A means to promote students' active learning; teachers do not relate it to the assessment reform, nor to the SBA

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Therefore…

- In order to identify ways to support teachers' implementation of SBA, a clear definition of authentic assessment is necessary.

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Enhancing teachers' competence in assessment

- Use their judgments about student performance, provide feedback, collaborate in designing learning, teaching and assessment tasks (Stiggins, 1997; Gipps, 1994)
- Mertler (2005) "assessment literacy", "understand which assessment methods to use to gather dependable information and student achievement, communicate assessment results effectively, and can use assessment to maximize student motivation and learning"

Stiggins, R. (1997). *Student-centered classroom assessment.* Englewood Cliffs, Nj: Prentice-Hall.

Gipps, C. (1994). *Beyond testing.* Washington, DC: Falmer Press.

Mertler, C. A. (2005). Secondary teahcers' assessment literacy: Does classroom experience make a difference? *American Secondary Education*, Spring, 33(2), 76-92.

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- Paterno (2001), assessment methodologies and techniques, alternatives to traditional measurements of learning
- Teachers need to have a belief that all students can succeed, separate feedback from grading, shift the focus of assessment to learning than performance and encourage peer assessment (Boud, 2000)

Paterno, J. (2001). Measuring success: A glossary of assessment terms. Building cathedrals: Compassion for the 21st century. Retrieved 8 March, 2005 from http://www.angelfire.comlwa2/buildingcatherdrals/measuringsuccess.html

Boud, D. (2000). Sustainable assessment: rethinking assessment for the learning society, *Studies in Continuing Education*, 22(2), 151-167.

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Findings on HK science teachers

- While teachers were ready to adopt a wider range of student work formats, they were shifting these innovations to be undertaken after lessons, which was on top of the usual assignment of homework to students
- This suggests that teachers may not be able to subscribe to the reform directions completely due to some constraints in their teaching

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Findings from HK science teachers

- Classroom practices did not seem to be in line with the demand for changes in practices and beliefs in assessment
- (Cheng and Cheung, 2001), range of students' work implemented by both the secondary and primary teachers was narrow
- Assessment of alternative forms of students' work such as performance; outdoor learning tasks and debates had not been attempted by almost half of all the sampled teachers

Cheng, M. H. and Cheung, W. M. (2001). Science and biology assessment in relation to the recently proposed education reform in Hong Kong. *Journal of Biology Education,* 35(4), 170-177.

Cheng, M. H. & Cheung W.M.F. (2005). Science and biology assessment in Hong Kong – progress and developments. *Journal of Biological Education,* 40(*1*),11-16.

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- School principals and secondary teachers are worried about the implementation of SBA and there were voices to delay the plan

  - 3 mismatches

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(1) Mismatch areas of science learning assessed through students' work

- Educational reforms and standards-based movements, importance of students' deeper understanding of concepts, the relationship of concepts within and across various subjects, reduced the importance for memorization of facts and theories
- In the study, comprehension and recall of science knowledge topped the list, lower emphasis on research in new areas

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(2) Conception of assessment and the purpose of examination

- Education reform in Hong Kong advocates "assessment for learning", the formative functions of assessment, in the study
- Examinations are still considered with great importance with all its related purpose receiving a rating of higher than 3.0
- Reflect the reality of current practices

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- The findings suggest that the teachers agreed on spending less time on examinations and having more time to attempt alternative assessment tasks and disagreed that examinations are the most effective way of motivating students to learn, and that these results well represent students' performance

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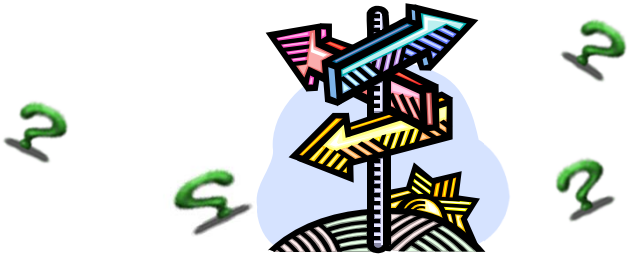
(3) Teachers' low self-perceived competence of assessment

- Difficulty with understanding and using a variety of methods for assessing students and setting high but realistic objectives for individual students



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Suggestions

- Teachers were not certain if they can spend less time on examinations and spend more time on projects
- Teachers need to visualize how new and old assessment practices are to be put in place at the same time viz, how formative functions of assessment is to be re-emphasized
- How to implement alternative assessment forms while they also prepare students for examinations
- Scenario for future directions of development also need to be shared with the teachers, for example, whether the percentage for SBA is to increase or maintain unchanged

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- Professional development opportunities that address the areas they perceived as least competent are needed including:
  - setting high but realistic objectives for individual students
  - assessing the strengths and weaknesses of individual students
  - communicating frequently with parents about how their children are performing in school

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Second Research Project

- Second study (Cheng, 2008) was conducted to support local secondary schools to implement authentic assessment which takes the form of scientific investigations.

Cheng, M. H.M. (2008). Identifying strategies to support junior secondary students to engage in scientific investigation tasks. *Canadian Journal of Science, Mathematics and Technology Education*, 8(2), 1-21.

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Research Procedure

- Six teachers teaching Science in four different local co-educational secondary schools
- One or two participating teachers in each school, with one of them taking the role of a coordinator if there was more than one teacher
- 575 students from 15 classes in four schools were involved. Each school identified a science topic for the design of a scientific investigation project at secondary one or two level or grade 7 to 8 (aged 12 to 14)
- Schools were provided with school-based support in order to develop scientific investigation projects based on selected science topics.

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Findings

- The learning outcomes of the students in the study were identified by the teachers to include students being able to develop the concept of a fair test,
- Students comparing their hypotheses with the findings in the investigations,
- The investigation tasks being found to be meaningful learning experiences for students of diverse abilities.

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Findings...

- Teachers saw challenges related to raising students' self-regulated and active learning abilities, and promoting group cooperation among the students
- A shift in the assessment culture, similarly the adoption of scientific investigation tasks as a form of authentic assessment entails a shift in the science learning and teaching strategies.

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- Introduction of self-planned and self-regulated scientific investigation tasks poses a challenge to both teachers and students
- Transition from textbook-based learning and paper and pen examinations cannot happen overnight

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Proposal of structuring scientific investigation tasks

Consist of two stages

Stage 1

A preliminary and an enhancing stage which takes into consideration students' prior science knowledge and skills, their experience in engaging in group work.

Stage 2

Their ability to engage in self-regulated learning tasks.

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Third Research

- Third study adopting the two phased model and the strategies identified to promote self-regulated learning abilities among the students
- Collaboration with nine teachers in four secondary schools to test out the implementation of the two phased model for conducting scientific investigation tasks

Cheng, M. H. (2008). The assessment reform in science in Hong Kong: policy, teacher beliefs and practice. In Coll, R. K. and Taylor, N. (eds.), *Education in context: an international examination of the influence of context on science curricula development and implementation*, (pp.333-342), Netherlands: Sense publications.

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Common forms of scientific investigation

- Students' previous experience, interest and confidence in themselves in conducting scientific investigations were identified in the interviews prior to the commencement of phase 1 of the project, The forms that students could recall having participated in were:

1. using a microscope (N=10),
2. lighting a Bunsen burner (N=5),
3. conducting experimental activities (N=4),
4. measuring things (N=3).
5. Most of the students (N=14) could not explain what was meant by an assessment rubric, but five could provide a brief description that it provides criteria for performance and that it shows high, medium and low performance levels.

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Findings

- Teachers were asked to reflect on their experience after the project during the interviews.
- Five out of the eight teachers reflected that the two phased structure of this project could help their students to understand the assessment criteria.
- These teachers observed that their students were aware of the requirements at different performance levels; they could target their improvements accordingly.
- The students became more reflective of their own performance instead of just striving to complete the project as required by the teacher

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Findings

- The teachers can also summarize from their experience ways to enhance students' understanding of the assessment or performance requirements, the need to adjust the levels according to students' learning needs, and being able to understand the requirements of the criteria themselves.
- Recognized the significance of continual support or repeated experience in using the assessment criteria so as to provide opportunities for students to apply their learning to new tasks, and for teachers to consolidate their newly acquired pedagogical skills.

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Future attempt

- Though some successful experience in the implementation at junior secondary level was obtained, future attempts need to experiment with the school-based support model at the senior secondary level:

1. some junior secondary science teachers are also engaged in teaching the senior forms, the implementation with students at different secondary levels may reveal different concerns.
2. senior secondary science teachers will be motivated to participate in similar science assessment projects when the time for the implementation of the new SBA is drawing nearer.

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Drawing these projects and experiences together

How best school systems come on top

- Improve teaching and learning, needs to find a way of changing what happens in classroom
- Create buy in from professionals, ownership from the profession

(Mckinery 2007)

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Effective improvement

- Changing instructional behaviour and practice of teachers
- Generates collaborative partners of staff development that focus on improving learning outcomes
- Emphasize development of professional learning communities and continuing professional development

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Professional learning communities

- Within, between and across schools
- Engage in collaborative work
- Participate in decision making
- Lead innovation and change
- Accept joint responsibility for outcome of their work
- Focus on learning and learning outcomes
- Use of evidence, data and current research to inform practice

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Engage teachers in action research and Collaboration within school

- Use data as a basis to refine practice
- Develop shared practice
- Move system forward
- Get every science teacher in the school to improve

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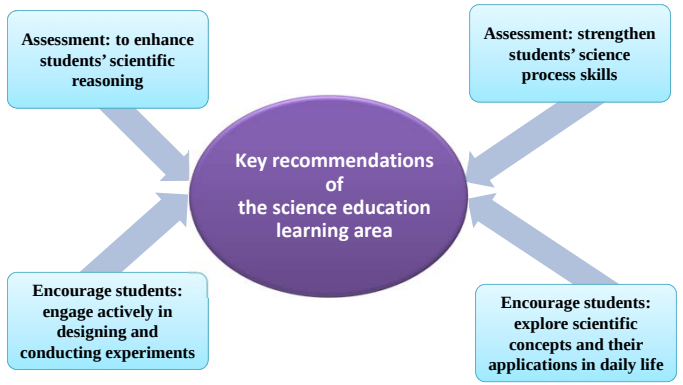
The key recommendations of the science education learning area



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(Curriculum Development Council, 2001)

Impact of research and research which results in impact

- Performance of universities are measured by impact of their research
- Our concerns as science educators: research which generates impact on practice and quality of education
- Application for research funding: a plan to generate impact

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Implications on types and structure of research projects

- Complementary roles of different types of research
- Long term development or target setting
- Linkages between projects
- Preparation phase e.g. preparing for changes to come
- Generating impact at the right time and climate e.g. readiness for changes, support in the system including school and system-wide support

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