Improving Teaching and Learning in Grade 11 & 12 Chemistry: Progress Report

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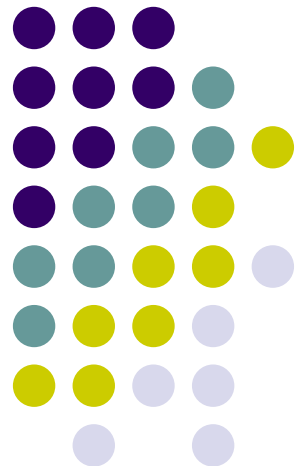
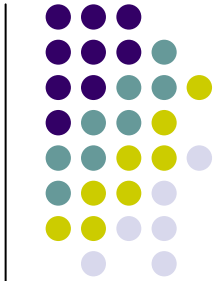


Focus of the U of M CRYSTAL

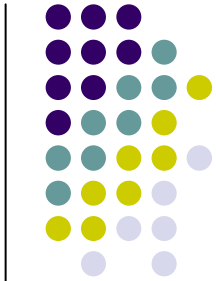


- Focus on fostering science & mathematics ‘development’ – student (elementary, middle years, senior years, tertiary), teacher, school & community.
- Two focus on chemistry education development in line with current research in chemistry education.
- One with teachers focusing on the implementation of the Grade 11 & 12 Manitoba Chemistry curriculum.
- One with chemistry teacher candidates and fostering their developmental aspirations.
- Both projects initiated because of the serendipitous changes in Manitoba Grade 11 & 12 Curriculum.

Improving Teaching & Learning Development Project

- ‘Development’: progressive change: next ‘steps’ from where you are now.
- The chemistry education development project was a purposeful choice for impacting change because of the ‘new’ curriculum as a supportive mechanism for teacher change.
- Based on a reality: Teacher change is rarely in ‘leaps’.
- Most curriculum changes make teachers aware of the change at a superficial level but do not cause pedagogical change (Harlen)
- Developmental change a ‘joint function’ of the characteristics of the individual (teacher in this case) and their environment: physical & psycho-social.

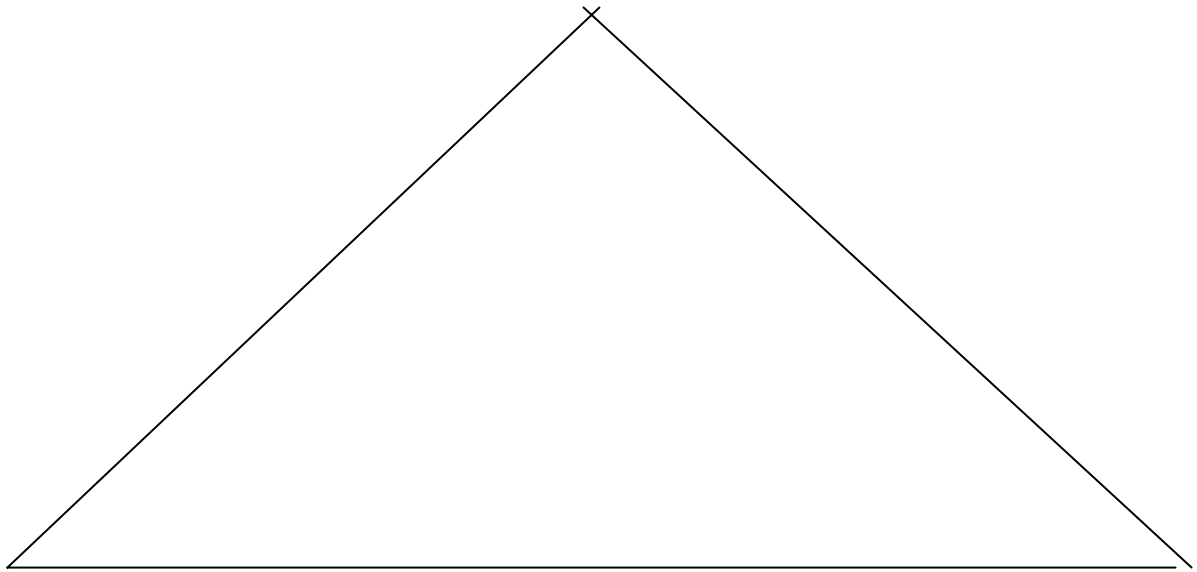
Improving Teaching & Learning Development Project



- Project focuses on supporting change through professional development
- Common characteristics of quality PD
  - linked to curriculum mandates & assessment practices
  - practical yet accompanied by opportunity for consideration, reflection and expectation
  - deliberate consideration of teacher identity: purpose
  - resource materials have to be easily transferable and modifiable.
  - participatory rather than dominated
  - supported by management over time
  - time dependent so must be provision of time & resources
  - led by credible individuals

Chemistry's Modes of Representation & the New Curriculum: Fostering Learning & Engagement

macroscopic or experimental (visual lab-based experiences)



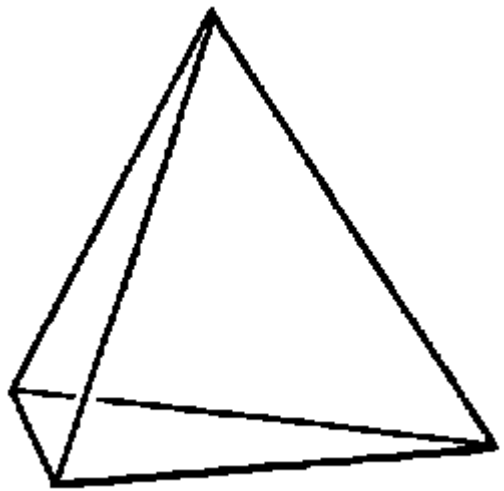
molecular (what we can't see but if we could, we would 'learn')

symbolic (how we express what is happening in abstract symbols & formulae)

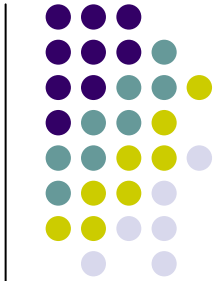
A Further Mode (Mahaffy, 2006) (The Tetrahedral)

- Arguably, the curriculum is not only at the molecular, macroscopic and symbolic but also the humanitarian level.
- Chemistry as a human endeavor - associated with chemistry in an historical and contemporary context (e.g., industry, body, environment).
- Curriculum is progressive from a chemistry ed perspective.
- Nationally and internationally.
- Questionable influence?
- **How can teacher development**

be fostered and what is its influence on students in terms of learning, interest and their future.



Evidence of Four Modes in the Curriculum



C12-6-03: Outline the *historical development* of voltaic (galvanic) cells. Include: contributions of Alessandro Volta, Luigi Galvani.

C12-6-04: Explain the operation of the a voltaic (galvanic) cell at the *visual, particulate, and symbolic levels.*

C12-6-11: Describe *practical examples* of electrochemical cells. Example: electroplating, electrolysis of brine, batteries.

Progress thus Far

- Third year of the project; just starting third phase of five.
- Three cohorts (~15 each) of teachers (South Winnipeg, RETSD (North Winnipeg) & West-Manitoba)
- 3 professional days for each cohort/second semester
- Involved 59 teachers, 28 are 3X returnees and have ongoing participation.
- Focus on one curriculum cluster per session: practical, participatory, reflective.
- 172 online resources available through CRYSTAL website (1400 downloads)
- Seven SAG sessions provided by 16 participants attended by ~ 185 teachers)
- Potential student influence: a few thousand at a minor ‘injection’ level and a few ‘hundred’ at an ‘immersion’ level.

Researchable Influence? Teacher Comments

- As well as the practical outcomes (PD, resources) ongoing researchable component.
- Ongoing questionnaires and interviews regarding practice: 28 teachers.
- Manitoba's 5 goals for science education: academic, utilitarian, vocational, humanitarian, intrinsic interest.
- Strongly 'encultured' academic rationalist orientation for teachers initially but not necessarily their true orientation. HS Chemistry as a foundation for future study: "You'll need to know this."
- Several comment on the re-establishment of orientations related to engagement and interest.

Researchable Influence? Teacher's Comments

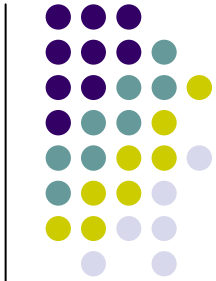
"I always enjoyed chemistry and becoming a teacher of chemistry was a logical choice. I wanted to instill that same interest. Teaching the chemistry in an interesting manner is often compromised by completing the course…I think this [PD & Curriculum] has brought me back to some initial motivations."

"I've made a school shift [change of schools for teaching] and the emphasis here is much more on the student and their learning. I focus more on their success and what we are doing [in the PD] is quite student centered and fits with that'.

Researchable Influence? Teacher's Comments

- Investigating what pedagogical practices that have changed with the curriculum and PD.
- (1) Written Personal Accounts of "Good Teaching Practice"
- (2) 32 common chemistry teaching practices: e.g., use simulations to explain what is happening at a molecular level (Likert-type scale response: never, seldom, sometimes, often).
- Significant changes in 6 areas evident: explain concepts fully, use a variety of means to explain, more visual examples at molecular level, less notes, more demonstrations, more experiments.
- Some other areas as well but unsure of significance (e.g., simulations, investigations, assessment practice).

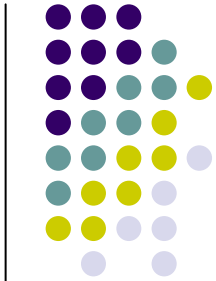
Researchable Influence? Student Comments



- 204 students: 162 Grade 11 & 42 Grade 12.
- 9 classes: 7 teachers: 8 Questions asked:

1. When were you last successful in chemistry?
2. When did you last enjoy what you were learning?
3. What is going on when you are enjoying chemistry?
4. What does the teacher do that best helps you to learn?
5. Why did you choose to study chemistry this year?
6. What would you change in the classroom to assist your learning?
7. Explain why you would choose to study chemistry in the future (school or postsecondary)?
8. What is going on when you are least enjoying chemistry?

Researchable Influence?
Student Comments



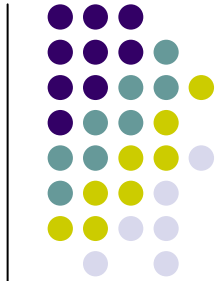
1. When were you last successful in chemistry?

high achievement (92), [mastering of concepts (63), performing experiments to end (44), working through calculations/problems (42), understanding ideas and catching on (38), being able to explain what has been observed (24), assisting friends (22)], never (6).

2. When did you last enjoy what you were learning?

we do labs/demos/investigations (71), when I understand what was happening (42), when its visual (implied molecular level) (42), mastery of specific topics (assigning oxidation numbers, stoichiometry, balancing equations, gas laws) (41), … never (9).

Researchable Influence? Student Comments



3. What is going on when you are enjoying chemistry?

   Labs, demos, experiments (124), completing work that I understand (28), discussions (24), not taking notes (21), … never (8).

4. What does the teacher do that best helps you to learn?

   Things that (labs, demos) connect to the learning (78), explains well (72), offers me help (62), lots of examples/different ways to get across the idea (32), notes (21), … nothing (3).

5. Why did you choose to study chemistry?

   future career – keeping options open (190), **enjoyed it last year (18) (5 Grade 11s/162) & (13 Grade 12s/42)**, expected of me/made to (5).

Researchable Influence? Student Comments

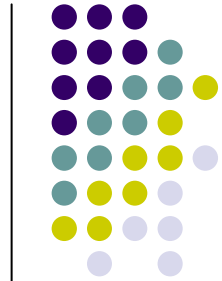
6. What would you change in the classroom to assist your learning? Physical aspects (124), less notes so we can focus on learning (21), more labs/demos linked to learning(17), better explanations (12), classroom dynamics (11).
7. Explain why you would choose to study chemistry in the future (school or postsecondary)? career (164), general understanding (22), interest (21), useful in my life (17), ….. never (7).
8. What is going on when you are least enjoying chemistry? copying notes (often without explaining) (72), tests and exams especially when not linked to what I've learned (67), lab reports (32), bad test or assignment results (31), classroom dynamics (29), too fast of pace (19), doing things I don't understand (21) teacher over-explaining (14),

Researchable Influence? Student Comments

7. Explain why you would choose to study chemistry in the future (school or postsecondary)? career (164), general understanding (22), interest (21), useful in my life (17), ….. never (7).

8. What is going on when you are least enjoying chemistry? copying notes (often without explaining) (72), tests and exams (67), lab reports (32), bad test or assignment results (31), classroom dynamics (29), too fast of pace (19), doing things I don't understand (21) teacher over-explaining (14).

Summary



- Very good level of ongoing participation.
- Very good participation in leading SAG sessions.
- Very good use of the resources – requires better advertisement.
- Very pleased with the means of measuring development and the evidence of the developmental progress as evident in teachers.
- Evidence that this effort is influencing teachers and their students.
- Two phases this year: assessment examples through website and PD sessions & classroom based research with teachers that wish to pursue it (4 small projects).
- Thanks to NSERC, George Bush, Rob Renaud, Gayle Peters.