CONCERNING ISSUES IN EXPLORING A REPRESENTATION INQUIRY APPROACH TO SENIOR SCHOOL STUDENTS

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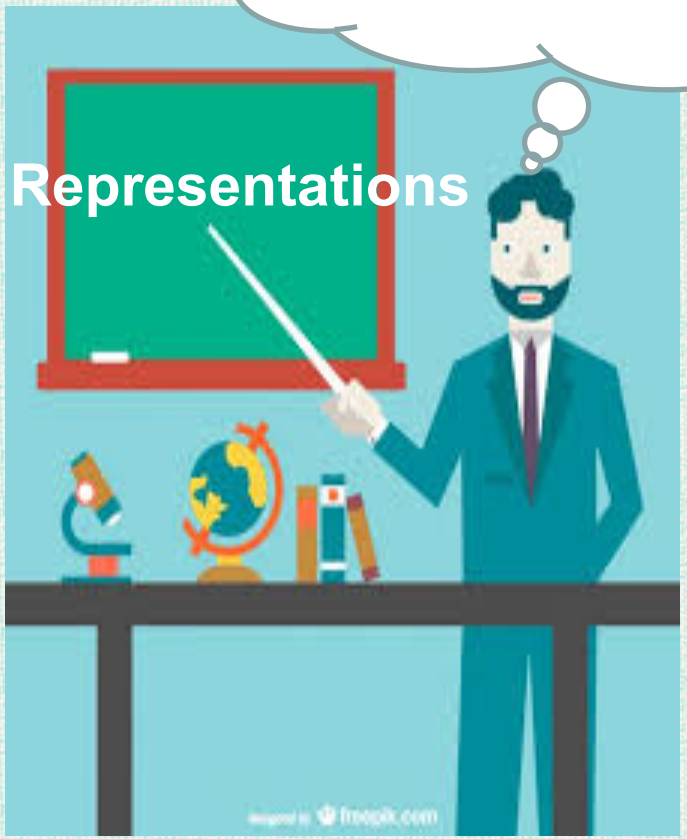
Outline

- Introduction and Aim of the research
- Theoretical frameworks
- Research methodology
- Findings

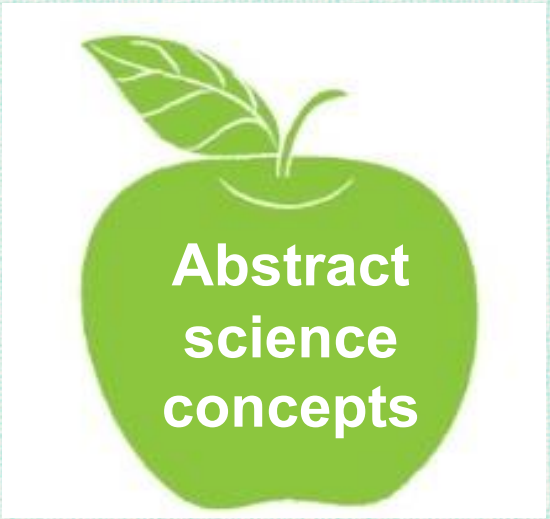
Introduction

graphs, models, images,diagrams etc.



Develop constructive and critical thinking
(Jonassen, 2003)

Interested in the learning process
(Ainsworth, 1999)



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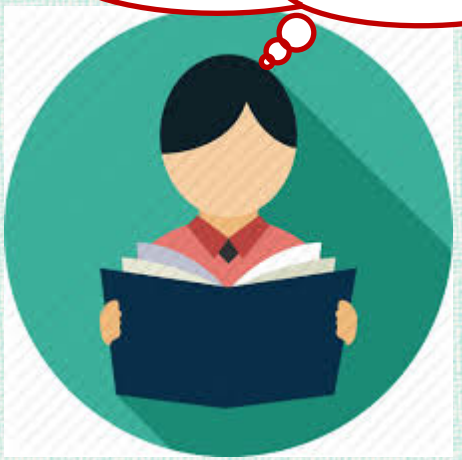
Introduction

Expert representations

How students learn from interpreting expert representations (Ainsworth, 2008).

The use of expert-derived visual representations to solve problems in chemistry (Wu, Krajcik, & Soloway, 2001).

Student self-construction representations



led to the development of problem-solving skills that could be applied in new contexts *(Prain & Tytler, 2012).*

Limited research

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Introduction

Student self-construction representations

Has not been widely utilised and extended to senior science.

My PhD research

How could the student RCA be effectively implemented in senior secondary schools, particularly in chemistry?

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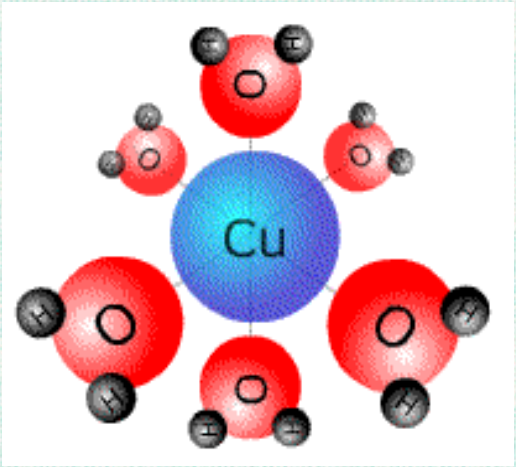
Aim

Describe issues associated with the planning and implementation of representational activities underpinning the RCA in classroom practices.

Theoretical frameworks

- Three levels of chemical representation (Johnstone, 1991)

Macro
(Real)



Sub-micro
(Real & Representations)

$$Cu^{2+} + 6H_2O(l) \longrightarrow [Cu(H_2O)_6]^{2+}(aq)$$

Symbolics (Representations)

Sub-micro interactions are unobservable directly

Representations are crucial to the development of chemistry understanding

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Theoretical frameworks

- **Representation construction affordances framework (Prain & Tytler, 2012).**
  - **Semiotic processes:** students recognize and know how to use science-specific material and symbolic tools to interpret/explain phenomena.
  - **Epistemic level:** students use a broad range of material and symbolic practices for undertaking and communicating science inquiry.
  - **Epistemological activity:** students construct and negotiate their own representations to establish meaning to explain how and why this representation construction work supports quality student learning.

→ The RCA framework helps explore why representational construction within a guided inquiry framework offers particular affordances for student learning of both the concepts of science and of scientific knowledge building practices (Prain & Tytler, 2012).

Research methodology

❑ Ethnographic design based research

- ➢ Involve a trial and refinement process.
- ➢ Design workshop.
- ➢ Collaboratively and progressively work with teacher to design the representational activities: practical, hands on and online activities.

❑ Participants

- ➢ 2 secondary schools, Melbourne, Victoria.
- ➢ Two year 11 chemistry teachers and two classes of these teachers.
- ➢ Classroom contexts: International students

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Research methodology

❑ Multiple data generation sources

- **Qualitative data:** video capture and students' artefacts, classroom observations, student and teacher interviews, questionnaires, and focus group discussions.
  - ✓ **Video capture:** Teachers' teaching practices and student discussions and interactions with the teachers and each other.
  - ✓ **The researcher observations:** Note the class sequences, activities and the teacher and student behaviours
  - ✓ **Students' artefacts**: models, diagrams, and pictures etc.
- **Quantitative data:** students' pre-, post- tests and closed-ended questions in the survey questionnaires.

Findings

- **Concerning planning issues**
  - The scaling of an approach to the more theoretical environment of senior chemistry.

    - At upper primary and lower secondary years
      - ✓ The curriculum and pedagogy are more engaged to the classroom activities ➡ More opportunities to incorporate representational activities.

    - At senior level
      - ✓ There are more theoretical issues introduced ➡ The chemical concepts are more sophisticated ➡ Challenges in unpacking key concepts and designing the activities.

      - ✓ Less opportunity to explore in a way that illuminates the very abstract concepts.

Findings

❑Concerning planning issues

- The scaling of an approach to the more theoretical environment of senior chemistry.

  - ✓ Complexity of the concepts to be taught that require many foundational concepts. Each of these concepts has a number of representational elements.

    - To understand a “Redox reaction process” students need to know/understand:
      - Half and full balanced redox equations
      - Oxidation number rules
      - Electron transfer
      - Electrochemical series

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Findings

❑ Concerning planning issues

- The scaling of an approach to the more theoretical environment of senior chemistry.

  - ✓ The classroom context included international students from different countries with different culture and chemistry backgrounds.

  ➡ Researching and making decision on types and contents of representational activities are challenges of the researcher and teachers.

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Findings

❑ Concerning implementation issues

- ➢ Time pressures in class time to enact representation construction
  - ✓ Main element of representation construction is student construction and evaluation of representation ➡ Considerable class time.
  - ✓ What was originally planned did not eventuate:
    - ○ Commitment by teacher to teach in an agreed manner/schedule with other Year 11 chemistry teacher.
    - ○ Teachers still had flexibility in their own teaching.

Findings

❑ Concerning implementation issues

- ➢ Time pressures in class time to enact representation construction
  - ✓ Lack of time to commit fully to all representational activities as well as manage suitable time for each representational activities.
    - The representation construction approach being student centred, usually took a long time, students were required to negotiate, generate and discuss the representational forms with their peers then construct their own representations.
    - The year 11 and 12 exam timetable was also a consideration.
    - My school doesn't allow for student teacher teaching rounds because of the high school fees and for this reason it was very important to make the research project meaningful and worthwhile.
    - Pre and post meetings with the researcher helped ensure success and allowed for last minute changes when needed.

Findings

❑ Concerning implementation issues

- ➢ Fluidity within teacher's usual teaching strategies/ lesson structure and the newly introduced student representation challenges.
  - ✓ Teacher introduced a canonical representation and then students revisited the concepts through representational challenges in different modes.
    - Traditionally, I have taught chemistry with a particular priority in mind and that is for the students to develop reliable methods to memorise key rules.
    - So in Redox Chemistry, I start off by talking about the possibility of a rusty train station boom gate rusting and falling then I go straight into rules by annotating their copies of the electrochemical series, showing students how to write half and full balanced redox reactions, how to predict and draw galvanic cell set ups. I use past Year 12 exam questions to guide learning expectations.
    - Students used the devised representational activities (at macro, sub-micro and symbolic stations) to demonstrate the theoretical concept. The stations and materials used were different to our usual science lab experiment or written work.

Findings

- **Concerning implementation issues**
  - Fluidity within teacher's usual teaching strategies/ lesson structure and the newly introduced student representation challenges.
    - ✓ Students constructed a representation of an experimental situation then they compared and were led to the canonical forms of representations.

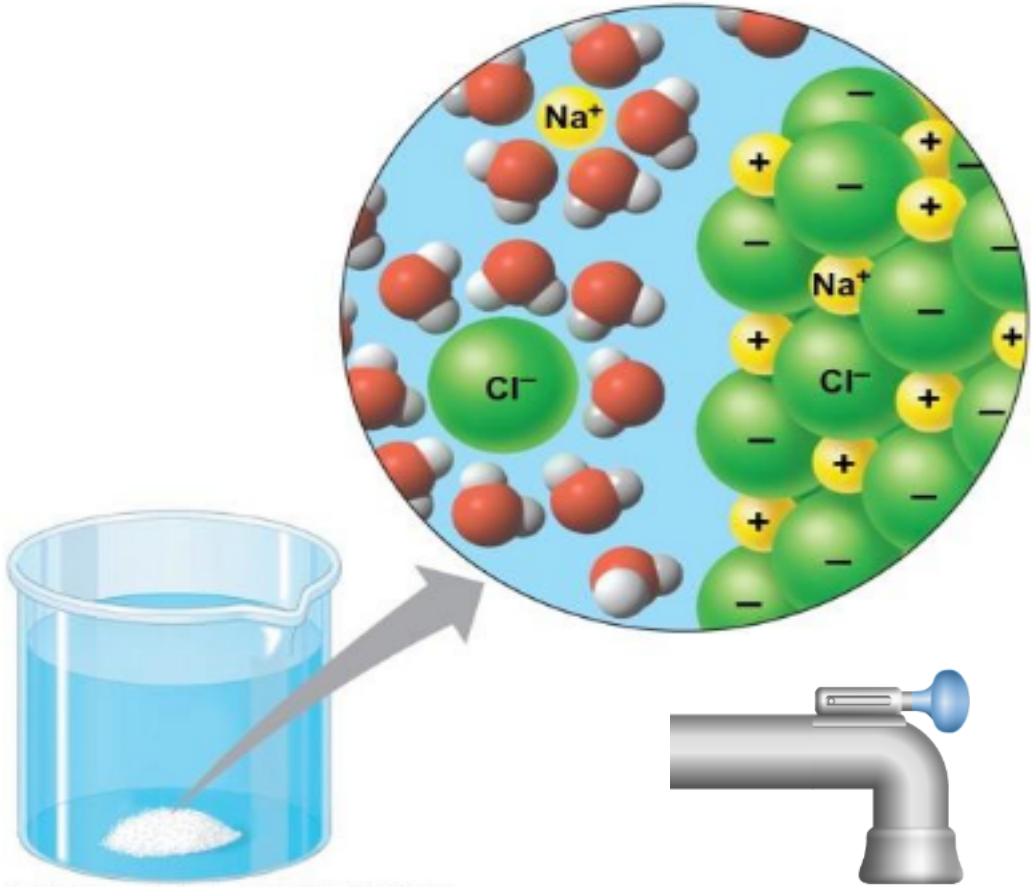
      - Dilution concept:
        - After students used actual solution to represent the cordial dilution concept, they draw diagrams and/or pictures to represent the mechanism of cordial dilution process.

        - The students compared their drawings and were led to the canonical representations in which the concept of dilution were introduced.

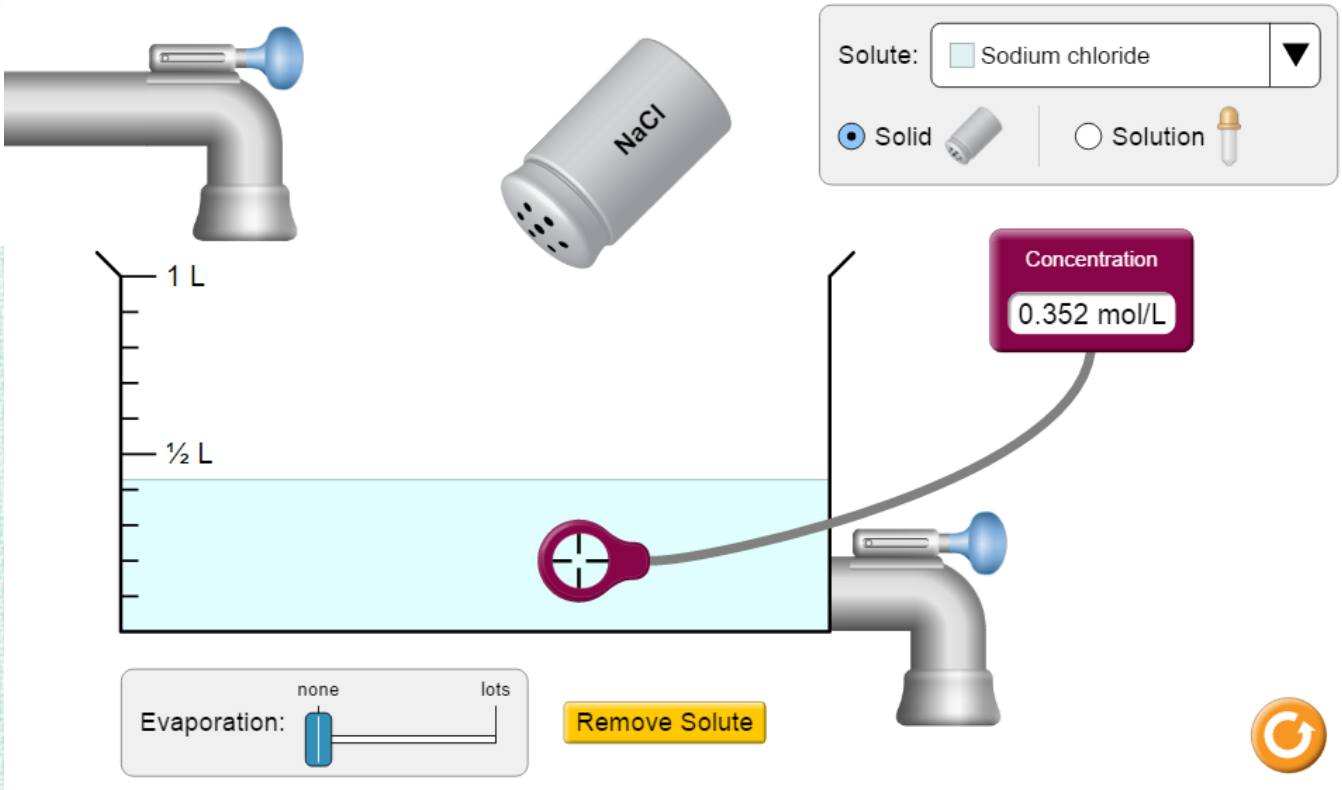
Findings

❑Collaboration issues

- Implementation of RCA: I needed to make sure that the introduced RCA was relevant to the VCE Chemistry study design.
- Students still needed to have time to complete previously set work/assessment.
- Extra hand/supervisor in class was helpful.
- Students were exposed to different chemistry language used by researcher.
- I.C.T (representational) activities/tasks matched Year 11 and 12 exam questions and knowledge.
- Needed to prove benefit to school by ensuring students' satisfaction, the activities were memorable. School seems to be up to date with the latest outcomes in educational research.
- Enriching for teacher: Update pedagogies, Professional learning development.


Na+
Cl−
Na+
Cl−

THANK YOU


Solute:
Sodium chloride
Solid
Solution
NaCl
1 L
½ L
Concentration
0.352 mol/L
Evaporation:
none
lots
Remove Solute

Findings

Lam

❑Concerning planning issues

- Challenge to create appropriate representational activities that address key concepts and is time efficiency.

  - ✓ Researcher spent time to review students' misconceptions in chemistry education at senior level.
  - ✓ Closely worked with teacher to find out the misconception topics/concepts in their classes.
  - ✓ Collaborated with teacher to design various types of activities for each topic: practical experiment, hands on and online activities etc.

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