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Report from EAP on teacher education - Stage 1

SAILS

Strategies for Assessment of Inquiry Learning in Science

Notes from a critical friend : Prof Deb McGregor (Oxford Brookes University)

Summary from the presentation of the report on progress (within WP 4 regarding Cohort 2[2] participants) provided October 9th 2014 : GA : Athens, Greece.

The progress of the project reported on is structured to consider:

1. Common Core elements that appeared to be present in the Countries TEPs reports reviewed.
2. What appeared to be 'good' and 'helpful' (highlights) in Cohort 2 reports reviewed.
3. Suggestions from the reports that might inform the Cohort 3 TEP Units and/or next steps of the project.

1. COMMON CORE COMPONENTS (INCLUDED IN ALL THE TEPS REVIEWED)

i.   **Introduction to IBSE**
A description which invariably included an introduction to IBSE. The kinds of ways that these 'introductory' components were provided for participant teachers ranged from a lecture (about IBSE) to a carefully constructed discussion about the nature of inquiry (that drew on prior reading of very appropriate literature). Slovakia, were the country that most conscientiously prepared for the introduction by providing pertinent references for the participants to read in preparation. This is an extremely effective way to have teachers engaged quickly and thoughtful with the often overlooked nuances of setting up good quality inquiry experiences for students.

ii.   **Hands-on experience**
All the workshops provided some aspects of "hands-on" experience. This varied and ranged from all participants carrying out the same activity and then collectively reflecting on it to workshop attendees rotating around a range of different inquiry activities (that included Assist-Me; Establish; Primas, Compass, Piko3).

iii. **Reflective or plenary discussions involving participants**
Discussion, included in the workshops, designed to share teacher views of "hands-on" experiences ranged from reflecting immediately after the practical experience to seminar discussions that were structured around having devised inquiries within a topic, and embedded formative assessment tools, trialed and evaluated these.

iv.   **Introducing assessment of inquiry skills**

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[2] This report synthesizes the content of the reports from several countries that had submitted their progress updates prior to the Athens meeting. The various country reports that were scrutinised included Germany, Greece, Ireland, Portugal, Slovakia and Sweden. The verbal discussion during the GA where England, Poland and ……contributed where they had progressed to was also included in this report.
[3] It was not clear, though, what these terms always meant. From the ways the reports were written, it could have indicated just 'looking', to increase familiarity, at a range of materials to experiencing using the resources from start to finish, working at the tasks as the (secondary) students might.

Description/Introduction to Assessment : ranged from a lecture to being formatively assessed on practicals as they were experienced. range of different skills to reviewing literature of assessing inquiry skills (prior to a workshop) as the teacher engaged in an inquiry by workshop leaders.

v.   Community of practice
Development of the Community of Practice for the participants ranged from introducing the existence of the CoP to using the website and network for exchanges in preparation between the teachers in readiness for the next (and subsequent) workshop.

2. Highlights of Good Practice and areas for development
(in relation to some of core components identified above)

i.   **Introduction to IBSE**
Preparatory Literature to read prior to a workshop can be most helpful. Given a range of 'inquiry' related materials to read appears to be a useful approach to developing teachers understanding of inquiry processes and outcomes.
Assessment of prior knowledge and understanding about IBSE before the workshop can inform more effectively targeted CPD.
Inquiry can be interpreted in many different ways, so it is helpful to clarify for workshop participants what inquiry skills are, how they can be developed and subsequently assessed.

ii.   **TEP workshops providing a range of "hands-on" experience (those more effective included :)**
A rotation around several different inquiry activities (of varied contexts) experienced by teacher participants so they can appreciate the range of appropriate practical opportunities is sensible. This can enable teachers to better develop their own inquiry activities, which can be illuminary for them (and support understanding of inquiry skill development).
Other features of good workshop experiences included 'Open' and 'Guided' Inquiry (as well as Prescriptive Practical activity) contrasted to enable experiential appreciation of different skills developed with more or less scaffolding (and direction). The opportunity to trial SAILS Units (readily available resources) and develop familiarity with such materials is also good practice.
The use (and application) of Assist-Me; Establish; Primas, Compass, Piko to nurture inquiries is not always clearly explained for (other) teacher educators to appreciate how these resources illustrate good inquiry skill development. Highlighting which practical activities promote which kinds of inquiry skills would be really helpful.
One country stated that a 'summary of the range of inquiry based projects was *given*' to participants, this may constrain successful use of the practical activities, if teachers do not have time to try out and reflect on the inquiry skills emphasised (or restricted) through hands-on experience of different kinds of activities.

iii. **Discussion to share teacher experience**

Features of good workshops included reflective discussions between teachers that varied and extended from educators sharing inquiry experiences to participants discussing AfI possibilities (and how to 'set-up' appropriate assessment of learning opportunities).

The opportunities to reflect on formative assessment after experience of inquiry activities and considering how different practical approaches can give rise to varied assessment opportunities that focus on different scientific skills is helpful for teachers. The chance to also reflect on task vignettes or transcripts of dialogue or talk in an inquiry situation to consider 'evidence' of inquiry skill development is an additional dimension of teacher education that can be very informative to help shape effective practice.

Finally, teachers devising inquiries within a topic, designing (formative and summative) assessment tools, trying them out, evaluating and reporting on the success (or not) of their learners through an extended dissertation. (Masters level) Accreditation for this appeared to be a great motivation.

iv. **Description/Introduction to Assessment**

Features of workshops that were effective, included reflective discussions about formative assessment after experience of inquiry activities, including 'objectifying' the nature of inquiry skills after experience.

Other useful experiences involved participants being formatively assessed whilst carrying out inquiry activities themselves.

Teachers also reflecting on the experience of being formatively assessed themselves in different ways and considering how the contrasting approaches would be appropriate for their learners is illuminatory. Teachers discussing vignettes or rich descriptions (including extracts of talk) of students carrying out inquiry to consider what or how formative assessment tools could be applied in their classrooms is also informative to shape effective practice.

v. **Development of CoP**

Features of workshops that were effective, included, all resources being used in workshops subsequently being available for teachers to adapt or 'run-with' via electronic means (uploaded onto the website).

Another effective aspect was the good quality resources (for example SAILS units) being readily available for the teachers to try out.

Further development of the CoP providing a range of materials to use as reference as well as teaching and assessment (classroom) resources would benefit participants in the project. Trying to generalize from practice to provide theorized approaches will help inform teachers' understandings about inquiry and the pragmatics of setting up of inquiries (and the associated assessment of the skills).

3. FURTHER SUGGESTIONS TO CONSIDER FOR COHORT 3
   a) Core Element 1 : Experiencing Inquiry & Realising assessment opportunities
   b) Core Element 2 : Trialing IBSE materials in schools
   c) Core Element 3 : Developing own IBSE tasks and assessment instruments

a). Core Element 1 : Experiencing Inquiry & Realising assessment opportunities : Useful features to include are:

- Ensure there is experiential opportunity for teachers to engage and reflect upon the nature of Inquiry and how to (peer) assess (some) inquiry skills
- Consider how to engage the teachers in realising the different inquiry skills that are brought to the fore in open and guided investigations.
- Consider how to help teachers realise the potential impact of (interactive and learning processes generated by different) members in a group :
    - All female
    - All male
    - Mixed gender
    - Making the implicit explicit

It is worth noting, and sharing with teachers when working with their students that :
'All genuine education comes about through experience.. [but that]…does not mean that all experiences are genuinely or equally educative'

(Dewey 1938 :25)

- Experience alone is not enough. We have to understand the significance of the experience. This comes about through guided and focussed discussion that takes account of both the theoretical intentions (of inquiry activities, i.e.: to enable learners to practice and hone their investigative skills) and also the pragmatics to ensure the 'practical' outcomes of experimentation work!

- The nature of formative assessment – there were many different methods and materials used to formatively assess. These varied significantly and ranged from 'flashcards', to socratic response systems to peer assessment rubrics to 'back-pocket' questions to poster presentations. The ways these different systems were used was not clearly written about in the reports, thereby limiting how 'good' and 'effective' practice might be more wide-spread amongst participants in the project.

b) Core Element 2 : Trialing IBSE materials in schools: Useful features to include are:

- Encourage the teachers to design their own inquiry, trial it with colleagues (in the workshop) and explore the focus and effectiveness of different forms of assessment
- Encourage reflections in subsequent workshops after the (developed) inquiries (and associated assessment approaches) have been trialed in school
- Encourage the collection of formative evidence (different forms) from classes to present and share with other teachers in workshops

Many practitioners, locked into a view of themselves as technical experts, find nothing in the world of practice to occasion reflection. They have become too skillful at techniques […] for them uncertainty is a threat, its admission of weakness.

Others, more inclined toward and adept at reflection-in-action, never-the-less feel profoundly uneasy because they cannot say what they know how to do, cannot justify its quality or rigour.

(Schön 1983 : 68)

c) Core Element 3: Developing own IBSE tasks and assessment instruments: Useful features to include are:

- Ensure teachers experience and understand the difference in formative and summative assessment of inquiry skills
- Ideally have teachers design inquiries (even within the same context) that are open and guided
- Encourage teachers to develop formative assessment tool or rubric focussed on at least one of these inquiry skills :
  - Developing investigations
  - Developing hypothesis
  - Working collaboratively (was debating with peers)
  - Forming coherent arguments
  - Scientific literacy
  - Scientific Reasoning
- Consider how colleagues (in TEPs) might trial each others to check for robustness (and possible inclusion in SAILS units).

More general comments about aspects of the TEPs and the project to consider:
A) Supporting continuous development for incremental learning (over several workshops)
Consider the steps (in subsequent workshops) of:

1. Teachers preparing for inquiry in-service training (prior reading and/or diagnostic test or pre- workshop questionnaire)
2. Teachers experiencing (open and guided) inquiry (and formative/summative assessment)
3. Teachers planning and designing activities for inquiry
4. Teachers recognising where the formative assessment opportunities exist
5. Teachers devising formative assessment tools for Inquiry skills
6. Teachers creating assessment rubrics for inquiry skills
7. Teachers trialing the inquiry activities and assessment tools
8. Teachers sharing and discussing (self and peer assessment) of the 'strengths' and 'areas for development' of their (inquiry teaching and assessment) resources
9. Teachers complete a post-workshop(s)/TEP questionnaire to indicate developed understanding and impact on their practice.

B) For Cohort 3 workshops: ensure a minimum of 10 hours
Within cohort 2 reports there are indications that there is a range of sessions that take from 5 hours to 60 hours total for a workshop. For teachers to appreciate and understand the nature of development of inquiry skills, i.e.; have sufficient time to experience and reflect upon maturation of them, it would be better to have successive sessions (with periods of trial and reflection between). Therefore, a minimum of 10 hours is suggested, TEPs could take the form of:

- 10 x 1 hour, or
- 2 x 5 hours

but where teachers have regular development meetings, it is likely to have a bigger impact if each time review of 'what happened' and then subsequent sessions offer 'next steps' in development.

Consider introducing a developmental design to the (series of) workshops, that are in essence, kind of Action-Research-like. That is, very simply, based on knowing what the teachers know about assessing inquiry skills, plan sessions (that are sequentially more demanding), but review incremental steps as increase range and reach of assessment strategies (Appreciative Inquiry cycles may be helpful too). That is ensure that consequent sessions 'build' on the previous ones and that prior understanding is built upon each time to ensure progress and maximum development.
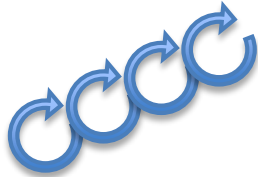
Adapted from McNiff with Whitehead 2002.

C) Evaluation

This could be considered in a variety of ways. There are some many instruments developed that could be applicable. One worth thinking about, because there are different levels at which the project is operating, is Guskey's 5 level model designed to assess impact (Guskey 2000). It could be applied to make judgments about success of the project at various levels (self, teachers, students, CoP members)*:*

- o Participant reaction;
- o Participant learning;
- o Organisational support and change;
- o Participant use of new knowledge and skills;
- o Pupil learning outcomes.

A project (useful framework used in Goodall et all 2005) that rather successfully applied the theory, could offer suggestions about how to develop the SAILS final report.

D) Areas (in TEPs) for development:
i. Consider group sizes and composition

When organising workshops, the ways that participants are managed to work together can impact quite considerably on the processes and outcomes achieved in inquiry activities. It would be helpful to continue to include consideration of impact of different kinds of working groups (pairs, trios or even larger numbers in a group as well as relative mix of male and female). It should be an aspect of the plenary reflections (and reflective discussions) to make it explicit for teacher participants to understand how this can affect learning in a scientific inquiry context.

ii. Consider Inclusivity

Inclusivity in inquiry activities. There are some evaluative comments from teacher participants that indicate there may be some barriers to all children engaging in IBSE. Another suggestion, then, is to consider how inquiries are 'presented' to be more or less inclusive.

iii. Clearly articulate the AfI methods and materials used (to share effective practice)

Examples of AfI techniques/tools/strategies (need to be more clearly articulated and the ways they are applied disseminated to benefit of the project) :

- Flashcards
- Modern assessment strategies
- Concept maps
- 'back-pocket' questions
- Class claps
- Sandwich technique (rubrics)
- Taking pictures of work
- Tarsias
- Socratic student response systems

The list above is not exhaustive, just indicative of the range of different methods (and materials) that can be applied in assessing inquiry skills. These need clearly describing and relating to (and referencing against) Wiliam's (2011) five key aspects. They should also be checked against Black and Harrison's (2010) work to be able to (perhaps even generalise[4]) about ways that particular kinds of skills will be better assessed in specific learning (inquiry) situations.

iv. Contextualising inquiries to augment authenticity

Consider how to better 'contextualise' the inquiries to develop more authentic investigations (Roth 1995). This may naturalistically draw the students (particularly girls, see Ivinson and Murphy 2007) to engage more actively in inquiry undertakings. Currently not all the inquiries included in the reports were strongly contextualised to relate and highlight which inquiry skills (e.g.: how many water drops on a penny? or how many straws are needed to build a 30cm high tower to support a 100g mass?) were successfully developed. It would be helpful to highlight (and cross tabulate) which inquiry activities relate best to nurturing which kinds of skills.

v. Scaffolding inquiry tasks to promote different kinds of discussion, thinking and actions

The ways that tasks are presented to learners (highly structured, somewhat scaffolded or open) can constrain or diversify thinking, discussion and (inter)actions that influence and direct decision-making that determines how inquiries might unfold (McGregor 2008). This has to some extent been considered and acted upon by some of the participant countries, but TEPs really need to consider how to effectively convey this to teachers so they can more efficaciously support a wide variety of inquiry skills.

vi. Matching appropriate formative assessment strategies to different inquiries

The various formative assessment strategies that have been mentioned and tried out in the project, have not yet been carefully considered to judge their 'effectiveness', nor have they yet been 'matched' or 'listed' to ensure that every kind of inquiry skill (is there a definitive and exhaustive list?) could be 'covered' (that is effectively assessed through a particular strategy or strategies). It would be useful to characterise the different strategies (Bell and Cowie 2000) and relate them to the different investigations and 'recognise' how they contribute formatively to learner's development.

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[4] Or more specifically relate to each of the SAILS units that will be produced and made available on the COPs and more widely?

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RESPONSE FROM SAILS PROJECT TO REPORT BY EAP MEMBER PROFESSOR DEBRA MCGREGOR

The SAILS team welcome the input of Professor McGregor as a member of the External Advisory Panel. Professor McGregor had particular input with regard to the Teacher Education Programmes.

Having reviewed the reports from each of the SAILS partners on their Teacher Education Programmes (Stage 1) and particularly on how assessment was incorporated into the teacher education programmes, Professor McGregor provided her main findings at the GA meeting in Athens. This was an extensive piece of work and was extremely helpful in drawing out key elements of the work carried out by each partner.

At the GA meeting in Athens, Professor McGregor made an oral presentation to the GA and there was time given over to discussion of her findings and recommendations. These inputs and discussions at that point were extremely beneficial in informing the teacher education programme for Stage 2 teachers. These discussions then allowed us to develop the final structure of the programme, which has been reported in D4.2. The three core elements of all SAILS STAGE 2 teacher education programmes have been identified as:

> Experiencing inquiry and assessment
>
> Trialling IBSE and assessment in the classroom
>
> Developing IBSE and assessment resources.

The Teacher Education Programmes with the final cohorts of teachers are now running and Professor McGregor will remain as an External Advisor to SAILS to further examine the programmes.

RESPONSE FROM SAILS PROJECT TO REPORT BY EAP MEMBER PROFESSOR DEBRA MCGREGOR