Innovative Inquiry-based Science Learning Environments in the Framework of PROFILES

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Goals of the workpackage

O4.1 To identify teacher needs and plan accordingly an intervention training programme with school science teacher teams using evidence-based best practice strategies.

O4.2 To create teacher training modules suitable for the promotion of IBSE teaching for enhancing students' scientific literacy.

O4.3 To establish a mechanism for the implementation of the intervention programme for the teacher teams to enable teachers to reflect on their practices and consider alternative best practices.

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Teacher needs

Driving the provision of a meaningful CPD within PROFILES is the identification of teachers needs, indicating gaps in the understanding or beliefs of teachers towards a new paradigm

Usefulness of seeking teacher needs

Teachers also need the confidence to implement the ideas in their teaching. This competence and confidence is referred to, in PROFILES, as self-efficacy

The intention is that through the PROFILES CPD, teachers build up the competence to appreciate and operationalise the new direction.

Sections in the teacher needs questionnaire

- 52 items that formed the following 10 subscales:
- nature of science : (items 1-6),
- STL (items 7-11),
- objectives of education (items 12-15),
- inquiry-based learning (items 16-19),
- learning environment (items 20-29),
- motivation (items 30-35),
- assessment (items 36-40),
- theories of education (items 41-46),
- self-analysis (items 47-50),
- integration (items 51-52).

Example of the questionnaire

			Confidence				Emphasis for CPD			
			V-very well	W-well	S-satisfactorily	D-do not know		1-definitely not	2-rather not	3- necessary	4- very
	Nature of Science										
1.	Explain to students that science cannot provide complete answers to all questions.										
2.	Explain to students the gap between school science and actual scientific research.										
3.	Explain to students the difference between science and pseudo-science.										
4.	Explain to students how scientists work.										
5.	Explain to students the difference between models and real processes.										
6.	Ensure students can distinguish between a law and a theory.										

Example of outcomes used for designing the CPD programme

Items	self-confidence	Emphases for courses	Difference
Q10: Refer students to a creative and reasonably to resolve the social dimension of natural scientific problems	M= 2,7; SD=0.60	M=3.5; SD=0.57	Z =-3.9 P=0.00
Q16: Distinguish between structured, guided and open inquiry	M= 2,5; SD=0.62	M=3.5; SD= 0.67	Z=-4.0 P=0.00
Q17: Guide students to put forward scientific questions and hypotheses for investigations	M=2.9 SD=0.55	M=3.6 SD=0.56	Z=-3,5 P=0.00

Modules enhancing the IL and ES in PROFILES

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THE PROFILES modules

Each module has

- a front-page, elaborating general information;
- student part;
- teacher's guide
- an assessment guide and
- possibly teacher notes.

Module components

In designing a module, the following components are important:

- *Module Title* which has a society orientation using words/situations familiar to students.
- *Learning Outcomes* are included: these cover cognitive, process, personal and social aspect of learning.
- *The Scenario* is motivational for students and is intended to stimulate discussion.
- *IBSE:* Students are involved in seeking evidence for the Science Question.
- Modules include a *Socio-Scientific Decision- making* component.

The Three stage model

The theoretical underpinning is related to three aspects :

- Student Motivation
- IBSE Problem Solving
- Socio-scientific Decision Making

Successful PROFILES Modules in Practice

- Stimulating and sustaining student intrinsic motivation and student centred learning environments.
- Developing scientific problem solving and socio-scientific decision making skills.
- Ensuring the evidence for problem solving is meaningful and the science learning is consolidated

PROFILES design structure

In the model, stage 1 seeks to:

Evoke the intrinsic motivation of students

by

Putting forward a relevant, meaningful and well understood title.
Initiating a scenario that has a local social context which has relevance for the students.
Evoking an emotional response from students by addressing a concern, issue or interesting situation

Reminder

- The scenario is not, in itself, about the learning of conceptual science, but an attempt to lead towards student appreciation of the value in learning the scientific ideas that will follow.

- An important constructivist component related to the scenario is determining the related students' prior science knowledge

From motivation to science learning

From the student motivational scenario, the task confronting the teacher is to maintain student motivation as the learning moves from

the contextual socio-scientific scenario to

the decontextualised science learning

Developing the science question to investigate

- The IBSE can be designed in different formats.
- **Structured inquiry** – the students follow instructions and put forward explanations (interpretations) of their findings
- **Guided inquiry** – the teacher guides the students who may develop their own investigatory plan
- IN BOTH OF THESE THE TEACHER IS LIKELY TO SUPPLY THE SCIENCE QUESTION
- If the students supply the science question and the investigatory plan, this is **Open Inquiry** – a PROFILES target.

Undertaking IBSE problem solving learning

- The problem solving is promoted through minds-on, hands-on, student-centred learning to enable problem solving to reflect on the validation of the data collection, the accuracy by which it is expressed and the interpretations that can be made leading to the solution of the problem.
- The learning involves conceptual science, practice of science and the Nature of Science, personal development and social development.

THIS IS STAGE 2

Consolidating the science learning

While consolidation of the science learning begins in stage 2.

- Stage 3, is an important step in the consolidation of the conceptual science learning and transfers the science learning back into a socio-scientific frame (the original scenario).
- The purpose of learning the science was to be able to better appreciate the socio-scientific situation and to be able to put forward a meaningful decision, which, in stage 1, was not possible because of the missing science knowledge.

Feedback or assessment

Assessment is expected to cover all aspects of learning.

In PROFILES modules this relates to:

- **Cognitive or intellectual development,** especially with
- **Appreciation of the Nature of Science;**
- **Development of personal skills**;
- **Development of social skills**;