SEISMO-LAB

Template for the Development of a Technology-Enhanced Educational Scenario Template

Inquiry Based Teaching

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1 Development of an Educational Scenario Template

1.1 Description of the Educational Scenario Template in Narrative Format

Describing an Educational Scenario Template	
1. Title of the Educational Scenario Template	Inquiry Based Teaching
2. Educational Problem	Main problems a) theoretical and abstract teaching b) textbook based instruction c) no demonstration infrastructure available d) students misconceptions
3. Educational Scenario Template Objectives	**Knowledge** The learners should know and understand specific concepts and the analogies between them. **Skills** The students should be able to: • Explore the research procedures themselves • Perform research efforts that are taking place as a structured discovery within the frame of organised teaching. • Design and conduct scientific investigations. • Formulate and revise scientific explanations and models using logic and evidence • Recognise and analyze alternative explanations and models. **Attitudes** The students should be able to: • Acquire an appreciation for basic Science Education matters through the exposure in similar topics • Communicate and defend a scientific argument
4. Characteristics and Needs of Students	**Cognitive** The students have less than average knowledge level to mathematics and geometry. Limited knowledge of science subjects. **Psychosocial**

Describing an Educational Scenario Template	
	Based on statistics less than 50% of the students have a significant interest in science (both boys and girls). A small number of them (about 15%) will follow careers in science (Sjøberg & Schreiner 2005, PISA 2006). **Physiological** The average age of students is 15-16 years. **Needs** The students should: • develop abilities necessary to do scientific inquiry • develop understandings about scientific inquiry • identify questions and concepts that guide scientific investigations • design and conduct scientific investigations • use technology and mathematics to improve investigations and communications • formulate and revise scientific explanations and models using logic and evidence • recognize and analyze alternative explanations and models • communicate and defend a scientific argument
5. Educational Approach of the Educational Scenario Template (a) Description of the Educational Approach rationale (b) Parameters that guarantee the implementation of the Educational Approach	(a) From a pedagogical perspective, **Inquiry Based Learning** is often contrasted with more traditional expository methods and reflects the constructivist model of learning, often referred to as active learning, so strongly held among science educators today. According to constructivist models, learning is the result of ongoing changes in our mental frameworks as we attempt to make meaning out of our experiences (Osborne et al, 2003). In classrooms where students are encouraged to make meaning, they are generally involved in "developing and restructuring [their] knowledge schemes through experiences with phenomena, through exploratory talk and teacher intervention" (Newton et al, 1999). However, we use *inquiry based learning* in a more specific manner, referring to a specific teaching model: an iterative process of (1) question eliciting activities, (2) active investigation by students, (3) creation, these are (4) discussed already at early stages of the process, leading to (5) reflection about

	knowledge and the learning process, which in turn leads to new and refined questions (1) and the process goes on for another cycle. (b) Students are likely to begin to understand the natural world if they work directly with natural phenomena, using their senses to observe and using instruments to extend the power of their senses. Moreover, students must have access to PCs that are connected to the Internet.
6. Learning Activities:	
Phase 1: Question Eliciting Activities	**Exhibit curiosity** The teacher tries to attract the students' attention by presenting/showing to them appropriate material. **Define questions from current knowledge** Students are engaged by scientifically oriented questions imposed by the teacher.
Phase 2: Active Investigation	**Propose preliminary explanations or hypotheses** Students propose some possible explanations to the questions that emerged from the previous activity. The teacher identifies possible misconceptions. **Plan and conduct simple investigation** Students prioritize evidence, allowing them to develop explanations that address scientifically oriented questions. The teacher facilitates the process.
Phase 3: Creation	**Gather evidence from observation** The teacher divides students in groups. Each group of students formulates and evaluates explanations from evidence to address scientifically oriented questions.
Phase 4: Discussion	**Explanation based on evidence** The teacher gives the correct explanation for the specific research topic. **Consider other explanations** Each group of students evaluates its explanations in light of alternative explanations, particularly those reflecting scientific understanding.
Phase 5: Reflection	**Communicate explanation** Each group of students produces a report with its findings, presents and justifies its proposed explanations to other groups and the teacher.
7. Participating Roles:	**Students** • Perform scientific prediction • Recording observations

Describing an Educational Scenario Template	
	• Perform prediction compared to results • Develop experimental models **Group Participant** • Use or evaluate a technique • Use science to explain **Teacher** • Presents ideas and evidence in science • Asks questions • Identifies misconceptions • Applies scientific methods • Develops experimental models • Provides historical and contemporary examples
8. Tools, Services and Resources	**Tools:** Hardware • Computer • Projector Software • Text, image, audio or video viewer • Database • VLE **Resources:** • Figure, graph, slide, problem statement, simulation, experiment, table, self assessment, exercise, questionnaire, exam.

Table 1: Description of the Educational Scenario Template

1.2 Graphical Representation of the Flow of Learning Activities

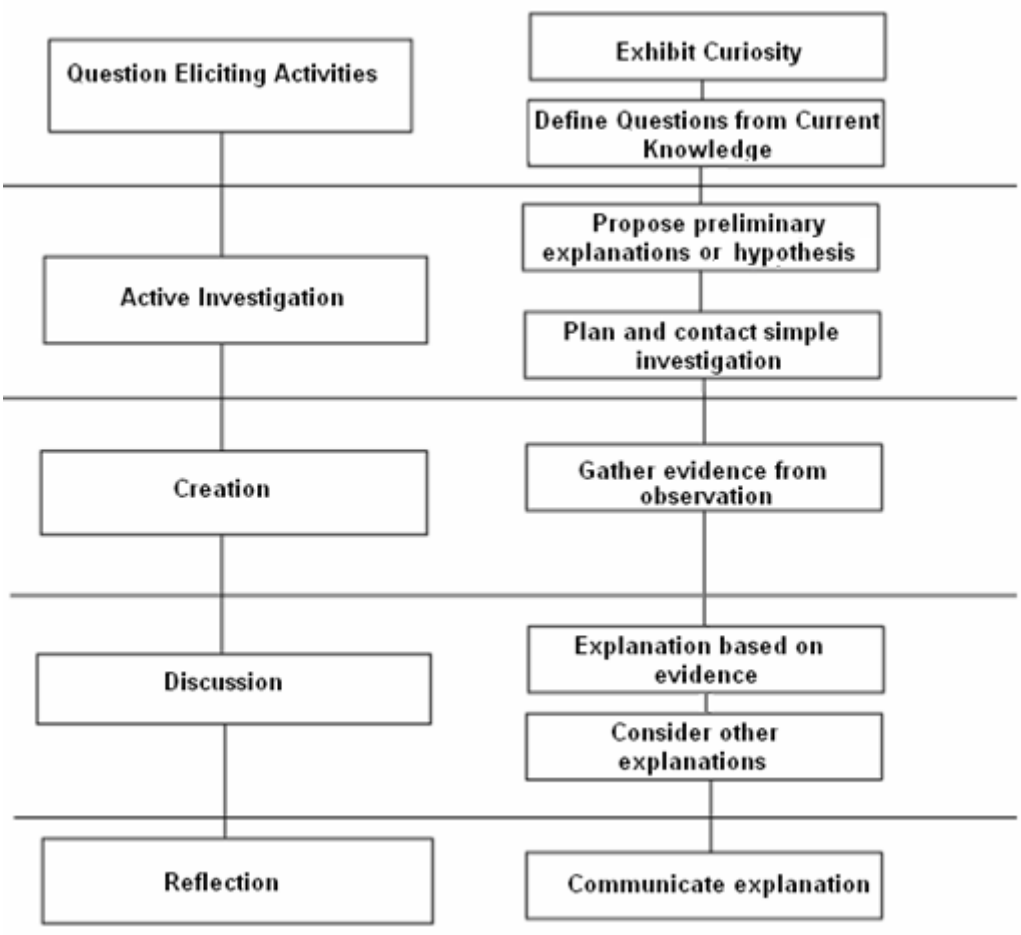

Figure 1: Flow of Learning Activities for Inquiry Based Teaching

1.3 Description of the Educational Scenario Template in Common Terms

1.3.1 Question Eliciting Activities

Phase 1 Question Eliciting Activities	**Type**	**Technique**	**Interaction**	**Roles**	**Tools/Services**	**Resources**
Exhibit Curiosity	Communicative Presenting	Information Handling Brainstorming	Who Class Based Medium Face to Face Timing Synchronous	Facilitator, Individual Learner	Hardware Computer, Projector Software Text, image, audio or video viewer	problem statement
Define Questions from current knowledge	Communicative Debating	Information Handling Brainstorming	Who Class Based Medium Face to Face Timing Synchronous	Facilitator, Individual Learner	Hardware Computer, Projector Software Text, image, audio or video viewer	other

Table 2: Question Eliciting Activities

1.3.2 Active Investigation

Phase 2 Active Investigation	Type	Technique	Interaction	Roles	Tools/Services	Resources
Propose preliminary explanations or hypotheses	Productive Synthesising	Adaptive Modeling	Who Class Based Medium Face to Face Timing Synchronous	Facilitator, Individual Learner	Hardware Computer, Projector Software Text, image, audio or video viewer	problem statement
Plan and contact preliminary investigation	Experiential Exploring	Experiential Experiment	Who Class Based Medium Face to Face Timing Synchronous	Facilitator, Individual Learner	Hardware Computer, Projector Software Text, image, audio or video viewer	simulation

Table 3: Active Investigation

1.3.3 Creation

Phase 3 Creation	Type	Technique	Interaction	Roles	Tools/Services	Resources
Gather evidence from observation	Experiential Experiencing	Adaptive Modeling	Who Group Based Medium Online Timing Synchronous	Facilitator, Group participant	Hardware Computer Software Database VLE	graph

Table 4: Creation

1.3.4 Discussion

Phase 4 Discussion	Type	Technique	Interaction	Roles	Tools/Services	Resources
Explanation based on evidence	Information Handling Analysing	Communicative Structured debate	Who Class Based Medium Face to Face Timing Synchronous	Presenter, Group participant	Hardware Computer Software Text, Image, Audio or Video Viewer VLE	graph
Consider other explanations	Experiential Exploring	Communicative Arguing	Who Group Based Medium Online Timing Synchronous	Facilitator, Group participant	Hardware Computer Software Text, Image, Audio or Video Viewer VLE	other

Table 5: Discussion

1.3.5 Reflection

Phase 5 Reflection	Type	Technique	Interaction	Roles	Tools/Services	Resources
Communication of the explanation	Communicative Debating	Productive Report	Who Class Based Medium Face to Face Timing Synchronous	Facilitator, Group participant	Hardware Computer Software Text, Image, Audio or Video Viewer Models VLE	other

Table 6: Reflection

2 References

Newton, P., Driver, R. & Osborne, J. (1999). The place of argumentation in the pedagogy of school science. *International Journal of Science Education*, 21, 553-576.

Osborne, J. F., Simon, S. & Collins, S. (2003). Attitudes towards Science: A review of the literature and its implications. *International Journal of Science Education*, 25, 1049–1079.

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3 Annex

The vocabulary used for the Learning Activities description in common terms, is explained in the following table:

Annex		
Dimension	**Type and Value**	**Description**
Type	Communicative: Presenting	Presentation of a specific subject/work
	Communicative: Debating	A structured discussion of opposing points of view
	Information Handling: Analysing	Analysing a concept or a problem
	Productive: Synthesizing	Synthesizing data into a new whole
	Experiential: Exploring	Students give priority to evidence, which allows them to develop explanations that address scientifically oriented questions.
	Experiential: Experiencing	Performing experiments and observations
Technique	Information Handling: Brainstorming	A problem or idea is defined and all participants make suggestions related to the topic.
	Adaptive: Modeling	Formulate models to explain hypotheses or findings from the observations
	Experiential: Experiment	Designing, Setting up and Performing experiments
	Communicative: Structured Debate	A structured debate based on evidence from observations
	Communicative: Arguing	A verbal dispute
	Productive: Report	Production of a report describing the process and the findings
Interaction	Who: Class based	In the context of the classroom
	Who: Group based	In the context of the groups
	Medium: Face to Face	Face to face interaction of the participating role with others or content
	Medium: Online	Interaction via the use of Internet
	Timing: Synchronous	Synchronous interaction of the participating role with others or content
Roles	Individual Learner	The individual learner
	Group participant	A student participating in a group of students
	Facilitator	The teacher in a role of facilitator of the learning process

Annex		
	Presenter	The teachers presents the outcomes of the discussion/debate
Tools/ Services	Hardware: Computer	An electronic, digital device that stores and processes information
	Hardware: Projector	A hardware device that enables an image to be projected onto a flat surface
	Software: Text, image, audio or video viewer	A software tool for displaying text, images, audio or video
	Software: Database	Educational Digital Library (e.g. DSPACE Library)
	Software: VLE	Virtual environment which engage users in learning activities (e.g. COSMOS portal)
Resources	Problem Statement	Document for defining a problem
	Slide	Hypermedia document
	Figure	A figure is any graphic, text, table or other representation that is unaligned from the main flow of text
	Graph	Pictorial representation of information
	Exercise	Document for practicing a skill or understanding
	Simulation	An application that imitates a physical process or object by causing a computer to respond mathematically to data and changing conditions as though it were the process or object itself
	Experiment	An action or operation undertaken in order to discover something unknown, to test a hypothesis, or establish or illustrate some known truth
	Table	An arrangement of information in columns and lines
	Self assessment	An assessment or evaluation of oneself, one's actions or attitudes by oneself
	Questionnaire	A list of questions by which information is sought from a selected group
	Exam	Document for testing, the knowledge or ability of students
	Other	It can be any of the following resources: Figure, graph, slide, simulation, experiment, table, self assessment, exercise, questionnaire, exam

Table 7: Learning Activities description