Designing and validating a didactical structure for a problem-posing approach to teaching decision making about the waste issue

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1. Introduction

The emergence of an *STS-approach* to science education with an emphasis on *decision-making skills* (Hofstein *et al*, 1988) and attempts at applying *constructivist ideas* about science teaching/learning to classroom practice (Ogborn, 1997) – two trends that ask for a didactical operationalisation.

The aim of the study is to design and validate a *didactical structure* (Lijnse, 1995) for the teaching/learning of decision making about the waste issue, starting from a *proper interpretation* of the students' existing issue knowledge and decision-making skill as being coherent and sensible (Klaassen & Lijnse, 1996) and using these productively to have them arrive at the very ideas one wants to teach through a *problem-posing teaching/learning process* which is driven by developing the students' own content-related motives (Klaassen, 1995). The above-mentioned aspects of design and validation are reflected in the four-fold research question for this study: what does such a didactical structure look like, what is expected of it in classroom practice, what happens in actual classroom practice as compared to what is expected, and which indications for its improvement does that offer?

2. Methods

The research design for the study is one of in-depth, small-scale and qualitative *developmental research* (Lijnse, 1995): a cyclical process of reflection on contents and teaching/learning process (including assumptions about the students' pre-knowledge and skill in the light of the educational aims), curriculum development and teacher preparation, and classroom research of the interaction of teaching and learning processes. This leads to an empirically based didactical structure for the teaching/learning of the topic under consideration.

A critical element in the research design is the use of a *scenario*, which can be seen as an extensive description and justification of the intended and expected teaching/learning process. The pre-trial development of a scenario allows a comparison to be made between the teaching/learning process as described in the scenario and the actual one as observed in classroom practice. In other words: the scenario explicitates the assumptions about the students' pre-knowledge and skill and about the outcomes of each of the student tasks, and thus allows these assumptions to be checked empirically.

The study spans two complete cycles of developmental research, featuring two successive experimental groups of grade 8 middle-ability students at the same school and taught by the same teacher.

3. Results

Designing the teaching/learning process starts with identifying an appropriate conceptual network of the waste issue in terms of the variety of life cycles of packages, and an adequate decision-making procedure in terms of evaluating alternatives on criteria (Carroll & Johnson, 1990; Baron & Brown, 1991), followed by interpreting the students' related knowledge and skill as quite sufficient. What still has to be learned, however, is the conceptual input into this procedure: the environmental criteria (depletion and pollution) and the criteria-related properties of packaging materials.

The resulting problem-posing teaching/learning process has two major parts. The first part connects to the students' assumed motive of wishing to contribute to 'a better environment' in order to induce a sense of purpose and direction for studying the topic. Their existing issue knowledge is then used productively for identifying the relevant environmental criteria. Using these criteria in decision making should make students aware of a *need for extending their issue knowledge*, as the hypothesised lack of knowledge about the criteria-related properties of packaging materials is expected to result in a number of questions for further investigation – a *content-related motive* that further drives their learning process. In the second part the teaching/learning process logically continues with having the students extend their specific issue knowledge and use this knowledge *for the purpose it has been extended for*: decision making about packages. The students' reports on their decision making are then used productively to learn about *presenting an argued point of view*. Finally students make the decision-making procedure and its required knowledge input explicit, and reflect on the usefulness of this tool for dealing with other environmental issues.

The first part of the teaching/learning process in classroom practice shows no major deviations from the scenario and does result in the expected questions about the criteria-related properties of packaging materials. This first part is therefore considered to be 'good enough'. This, however, does not apply to the second part: unexpected controversy over the reliability of data found in the investigation and stagnation in developing standards for the presentation of an argued point of view. What is lacking here – in hindsight – is a focus on creating a need for reflection on the students' decision-making skill (that is, their *presentation* of an argued point of view), resulting in another *content-related motive* that would further drive their learning process towards developing a metacognitive tool for an improved performance of this skill (that is, a *presentation standard* for an argued point of view).

4. Conclusions and Implications

On the basis of the empirical evidence it can be hypothesised that an improved scenario and classroom practice will make the teaching/learning process progress as intended in larger scale testing to further establish the validity of the didactical structure and to assess its learning effects.

The 'final' didactical structure can be seen as an example of the interrelated development of issue knowledge and decision-making skill, driven by the students' own content-related motives – and therefore as a useful starting point for designing teaching/learning processes which solve – at least to some extent – the problem of the subordinate role that conceptual science knowledge appears to play in students' decision making about socio-scientific issues (Fleming, 1987; Solomon, 1992; Ratcliffe, 1997).

At a more general level the core of this didactical structure could be described as bringing the students in such a position that they themselves first come to pose and want to solve a 'knowledge-related problem in the context of a skill-related issue by reflecting on the use of their existing knowledge' and at a later stage come to pose and want to solve a 'skill-related problem by reflecting on the use of their existing skill'. Such a generalised didactical structure could be considered useful for further developmental research on teaching other complex intellectual skills such as problem solving.

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