Report from the FP7 project:

Assess Inquiry in Science, Technology and Mathematics Education

Assessment Method Description for 'Innovation' Competence

Peer-Assessment of Technical Sketches

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Introduction and summary

This description introduces one possible way of using peer-assessment in technology classes or related subjects (Nature and Science, Design...) for the evaluation of technical drawings.

Technical Sketches (or drawings) are the starting point for the development and design of models of solar-powered vehicles which will be compared by the students in a final competition.

Subject	• Technology- related subjects, technology
School level	• Assessment method generally adaptable to lower and upper secondary level • Paradigmatic example in secondary school, level 1
Assessed competences	• Cooperating • Cummunicating • Working systematically • Being creative
Data collection about student learning	• Technical sketches of classmates, drawn data
Feedback method	• Partner- or peer-assessment
Combination with summative assessment	• Paradigmatic example and feedback method for formative assessment, but task generally usable for both formative and summative assessment

Table 1. Overview of the example “Peer-assessment of Technical Sketches”

Description of Feedback Method with Guidelines How to Use it

"Peer-feedback" describes formative assessment which is conducted by student peers. This chapter will provide a description of the principle along with short summaries of different varieties.

In both self-and peer-feedback, it is of central importance that the goal of a task and the criteria of evaluation are understood well by the students (Sadler, 1989; Black et al., 2003). Black et al. (2003) suggest supporting this understanding by showing examples.

Both self-and peer-feedback allow the teacher to freely move between the students and concentrate on individual problems since she / he does not carry the responsibility to do all the assessment of the whole class.

The process of peer- and self-assessing pieces of work from time to time should help the students to bear in mind the aims of their work and therefore assist them in becoming independent learners (Black et al., 2003).

Why you should do this

Peer-feedback follows the idea of "activating students as instructional resources for one another" (Leahy et al., 2005). Peer-feedback is seen as particularly powerful since *"students may accept criticisms of their work from one another that they would not take seriously if the remarks were offered by a teacher. Peer work is also valuable because the interchange will be in language that students themselves naturally use […]"* (Black et al., 2004, p. 14). The same authors find evidence that *"when students do not understand an explanation, they are likely to interrupt a fellow student when they would not interrupt a teacher." (Black et al., 2004, p. 14).*

However, Black et al., 2003, also mention that before being able to assess their peers' work, they have to learn how to behave in groups (listening to others, taking turns) and how to communicate their feedback usefully.

In reciprocal peer-assessment, students undertake both the role of the assessor and the assessee, by assessing each other's work. Performing the peer-assessor role requires students to have and practice their assessment skills, namely: *defining criteria, judging the performance of a peer, and providing feedback* (Sluijsmans, 2002). Students could be supported through the provision of scaffolds while performing each one of these assessment skills. For example, if students are novices in peer-assessing and have no prior experience on how to define assessing criteria or what has to be measured in the learning process and thus compose assessment criteria, they could alternatively be provided with those criteria from the teacher, in order to better execute their task.

Paradigmatic Example: Technology, Upper Secondary Level

The topic of the paradigmatic example is the development and design of solar car models. Solar cars are vehicles powered by solar energy. A functioning model of such a vehicle is to be created in class and the results will then be compared and tested by all students in a final competition.

Prior to the start of the design process, students can be encouraged to develop hypotheses based on a set of questions. For example:

- …Which materials are especially suited for the purpose and which are not? Why?
- …Which characteristics does a model vehicle need to have in order to be fast?
- …In how far is there a connection between materials used and way of driving?
- …

For the development and design process, students who (could) work in pairs, have access to a variety of materials from different fields. For example (list not exhaustive):

- 1 solar module assembly kit (3 V / 7.5 V) as power unit
- Glass
- Plastic materials (foil, sticks, bolts, other semi-finished materials etc.)
- Metals (iron and non-ferrous metal sticks, bolts, other semi-finished materials etc.)
- Wooden semi-finished materials
- Composite material
- Joining elements (screws, nails, clips etc.)
- Auxiliary material (threads, wire, tape etc.)
- …

Students are to devise one or more technical drawings of their models during the development phase and are explicitly requested to work together as a team.

Characteristics of Technical Drawings

Ideally, technical drawings display the following characteristics:

- The drawing is not to scale
- The proportions should be approximately consistent
- Drawn by hand and without auxiliary devices
- The purpose is a fast representation of technological objects
- Often used for the design of models
- All measurements and other data need to be included in the drawing.

Despite the fact that due to the relatively open nature of the task there cannot be one singular, correct solution, it is to be expected that the final competition will be won by a model which is based on a lightweight construction. An indicator of a good solution is therefore the use of light materials in a material-economical production which guarantees a minimum net weight of the model.

The Assessment

The peer assessment begins during the development phase of the lesson. It covers many areas, refers to the students' technical drawings and is aimed at factual and technical knowledge as well as socio-communicative aspects during the designing phase of the lesson.

At different points of the lesson, students can be asked to exchange their drawings in tandems (groups of two). Thereby they describe and discuss successfully realised aspects of the work, give feedback on what requires improvement, and further explain which questions or problems have occurred during the assessment of the technical drawings.

They are also given the opportunity to respond to the support and the feedback of others by conveying which pieces of advice have been useful, incomprehensible or not constructive. Thus, the feedback given not only relates to the object itself (the development and drawing of a solar car model) but also to the social issues involved. Below is an example of such a feedback method:

	That worked well… ☺ That helped me… ☺	I would improve … ☹ Here I'm stuck… ☹	I have a question concerning… ? What did you mean by…? ?
Round 1 Technical Aspects (e.g. feasibility of building a model, design, materials used...)			
Social Aspects (e.g. teamwork, communication…)			

Round 2 Technical Aspects (e.g. feasibility of building a model, design, materials used...)			
Social Aspects (e.g. teamwork, communication…)			
…	…	…	…

Illustration 1: Tandem Assessment Grid

The partner assessment procedure can be repeated over several rounds. The following illustration depicts the feedback process:

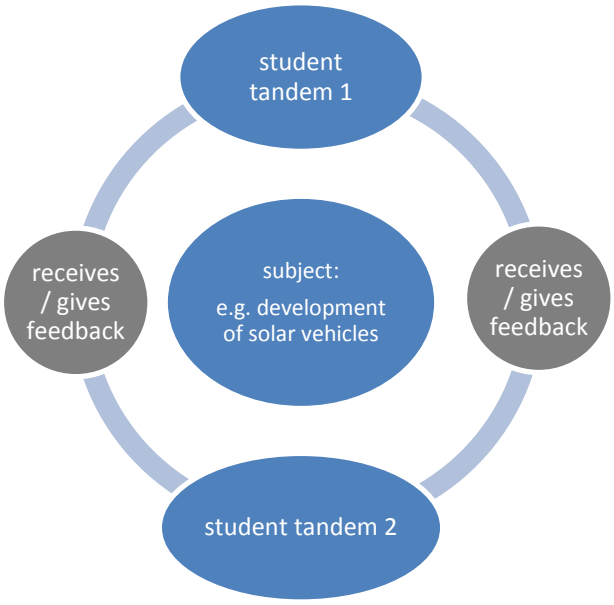

Illustration 2: Partner Assessment in Several Rounds

Accordingly, feedback is given over two or more rounds. Each student tandem is assigned to another student tandem. This is meant to create a reciprocal information exchange in which each tandem receives feedback at least twice. The feedback can relate to teamwork, the students' communication about the feasibility of building the

models, the design, the materials used, technological aspects (circuit design, style…), the creative process etc.

Depending on the students' prior knowledge, the teacher may guide the feedback procedure by providing assessment criteria, acting as mediator, directing attention to crucial aspects or supporting the students in their efforts to formulate their own assessment criteria.

The partner assessment method described above is transferable to the design of further technical drawings in relation to any other subject or problem.

References

Black, P., Harrison, Ch., Lee, C., Marshall, B., and Wiliam, D. (2003): Assessment for learning: putting it into practice. Open University Press, London.

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