Comments on C1: Communication skills for teaching (*Anna Maria Pessoa de Carvalho)*

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In this chapter, Carvalho emphasizes the importance of teacher communication skills for the implementation of curriculum innovation. Hestenes [1] has observed that "the most critical element in successful implementation [...] is the skill of teacher in managing classroom discourse." These skills "... are found to be hard to teach, and are often the result of many years of classroom experience" Wells et al [2] noted in the context of undergraduate physics education. Carvalho shows how the communication skills essential in the physics classroom go far beyond the traditional discursive practices. This chapter gives give examples, that can be used in teacher education to help student teachers acquire and develop communicative skills for the physics classroom.

Introductory sections of the chapter discuss different types classifications, including teacher roles (focus, approach, actions), communicative approaches (interactive or non-interactive, dialogic or non-dialogic), and different types of non-verbal communication. The development of a correct use of words in the discussion and ways to describe graphical representations, as well as the importance of combining different representations for the same phenomenon are aspects emphasized in this chapter.

The teacher action is analysed for a number of teaching episodes involving middle school class discussions. The examples provided show how teachers can lead students from an intuitive understanding, expressed using inexact everyday words, to an appreciation of more scientific terms, by bringing their attention to the various ways different students have expressed their understanding.

In a teaching situation, a teacher has to make quick decision on what path to follow, which threads to pull and which to leave. The discussion in first episode in the chapter concerns how different molecules are affected by microwaves and is a diversion from the intended discussion of the boiling point for water. Is the diversion worth it? What is the possible outcome? Can it be expected to connect to anything the class has done, or to something that is planned for the class? The teacher has to weigh the different options. The discussion episode presented reflects a possible ambivalence of the teacher: The dialogue shows the teacher and the class moving between the two themes, but also the teacher encouraging other ways to enrich the discussion by connecting to everyday experiences. The teacher will have to decide whether to follow up the additional context. Is the common view correct, i.e. that only water molecules are affected in a microwave oven? Could the class come up ways to examine this statement or perhaps think of counterexamples? Would this type of questions be more suited as a task suggested individually for an under-stimulated student who would need an additional challenge? The teacher who has to make the choice knows the students, but the reader does not. The resulting visible action is only the tip of an iceberg.

A middle-school student comment that "A water molecule evaporates at 100 degrees" may open for a discussion in teacher education about distribution of molecular speeds and its relation to temperature. Even young learners may have noted that water can evaporate for temperatures far below the boiling point, and may bring questions about this apparent contradiction.

In a later example, students measure the temperature of water when it reaches the boiling point. The boiling point temperature of 97°C is accepted in the classroom without questioning and without discussion about possible cause for deviation from the textbook value. The variation in results between the different groups in the classroom could be a good opportunity to discuss measurement uncertainty: Is the uncertainty sufficient to explain the lower boiling point, or could the value possibly be accounted for by the elevation of 800 m in Sao Paolo?

If the text is used in teacher education, the student teachers can be asked to think about what questions could arise in a class during the discussions. If possible they could also try out lessons in a classroom on the same topic and collect questions. These questions can then provide extra motivation for deeper learning the physics involved - school children's curiosity is not necessarily limited to what is specified in the curriculum.

Another way to use this chapter in teacher education may be to have groups of student teachers role-play the teaching episodes, first once, as they are presented. After allowing for a couple of minutes of small-group discussions with neighbours, the episode could then be role-played a second time in a forum-play format, allowing the fellow students to interrupt and to act as middle-school students and bring in their own questions, comments and ideas, possibly based on their authentic classroom experiences. The teacher educator can then bring out and clarify possible unclear concepts and common student problems in the context.

The student teachers may also try out variations of the teaching strategies for the episodes and reflect on what options it offers for student engagement. The Reformed Teaching Observation Protocol (RTOP) [3] offers a formalized structure for peer observation concerning interactivity in the classroom, giving a score which has been found to correlate with learning, as measured with gains on different diagnoses.

The teachers' pedagogical content knowledge (PCK) [4] of a topic, includes the knowledge of the relevant science in combination with a knowledge of student understanding and difficulties concerning the topic. The episodes provided in this chapter give many possibilities to the teacher educator to help develop the student teachers' PCK, including the special communication skills required in physics classroom.

References

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