Practical work revisited: A case study using a lesson study approach

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Practical work is a standard part of physics education. It serves to teach the skills of experimentation and to contribute to conceptual understanding. Also hands-on science is supposed to make learners understand how science works, by involving students in empirical research. However, these multiple goals can cause an overload of the practical. In turn this can lead to overscripted practical instructions, reducing the effectiveness of practical work (Abrahams & Millar, 2008).

As a response the Getting Practical method was developed as a means of revisiting goals and effectiveness of practical work (Millar & Abrahams, 2009). Starting with defining what learners have to learn, this is translated into learning activities. The next step is to check what is actually done and finally what is learned.

In this paper we present a case study in which the Getting Practical approach was implemented and optimized using the method of Lesson Study (Verhoef, Tall et al, 2013). In this approach teachers collaboratively (re)design a lesson. One of the teachers performs the lesson and the colleagues observe. Based on the observations, a second cycle of redesign completes the cycle.

In our case study, the physics teachers of a large secondary school reported that learners miss the relation between practical and theory and lack conceptual understanding of the physics that is subject in the practicals. Using the lesson study method teachers together redesigned a practical on calorimetry. In the original lesson teachers scored 10 goals out of a possible 17 as learning goals for the practical. The result was that learners only focused on the practical execution of the task, without paying attention to achieving learning goals.

Discussions in the teacher team resulted in a reduction of the number of learning goals to only three: better understanding of calorimetry, careful measurements and drawing conclusions. Also workload should be reduced for both learners and teachers. An article on student understanding of calorimetry (Christensen et al, 2011) was used as a theoretical basis.

The practical was simplified, e.g. by omitting computer measurements, and conceptual questions were added to the written instruction. During the practical, learners discussed their understanding of heat capacity. The lesson was observed by all teachers, and based on the observation outcomes the lesson was further improved. The redesign removed the time and workload problems. Also teachers now can easily assess students' work. Important spin-offs using this approach are team building, professional development of teachers (Clarke & Hollingsworth, 2002) and an open lesson culture. In conclusion, this case study shows lesson study to be applicable and useful for the redesign of practical lessons. More case studies will be performed to further determine the way Lesson Study and Getting Practical are a good match.

References

--Abrahams, I. & Millar, R. (2008). Does Practical Work Really Work? A study of the effectiveness of practical work as a teaching and learning method in school science. International Journal of Science Education, 30, 14, 1945–1969.

--Clarke, D., & Hollingsworth, H. (2002). Elaborating a model of teacher professional growth. Teaching and Teacher Education, 18, 947–967.

--Christensen, W.M., Meltzer, D. E., & Nguyen, N-L. (2011). Student understanding of calorimetry in introductory calculus-based physics. American Journal of Physics, 79, 1168-1176.

--Millar, R. & Abrahams, I. (2009). Practical work: making it more effective. School Science Review, 91, 59-64.

--Verhoef, N., Tall, D., Coenders F., & Smaalen, D. (2013). The complexities of a lesson study in a Dutch situation. International Journal of Science and Mathematics Education. Published online 24 October 2013.