SUPPORTING BIOLOGY TEACHERS IN DEVELOPING EXAMINATION TASKS – AN ACTION RESEARCH APPROACH

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International studies of students' performance (e.g., PISA, TIMSS) have led to rethinking school-based teaching and learning in many participating countries as well as in Austria. The ability of students to apply knowledge in meaningful situations is a key competence for the full participation in society and therefore becomes the future standard for students' achievement. Such a point of view contrasts with the traditional focus of school-based teaching and learning on the reproduction of knowledge. This paradigmatic shift calls for a major change in teaching. Therefore, the Austrian Educational Competence Centre for Biology (AECCbio) offers various professional development courses that help biology teachers to modify their teaching practice. The paper presented gives an insight into our work with biology teachers regarding the implementation of the new regulations for the final examination in upper-secondary schools. We will introduce our current course model and elaborate on the process of course improvement within the research framework of Action Research. The results show that difficulties arise when teachers develop tasks that require the candidates to apply acquired knowledge when solving complex problems. Most tasks solely demand the reproduction or reorganisation of factual and conceptual knowledge within theoretical application contexts. Implications for our TPD course model will be discussed in the paper.

Keywords: Action Research, Competence-oriented examination tasks, Teacher Professional Development

TEACHERS DEVELOPING COMPETENCE-ORIENTED EXAMINATION TASKS

The disappointing results of Austrian students' performance in comparative international studies of students' performance (e.g., PISA 2003) led to manifold structural reforms of the Austrian educational system (Lucyshyn & Lucyshyn, 2009). The school system became controlled by standards which define the expected students' learning outcomes (Schiffl, 2016). These standards determine that mere acquisition and reproduction of subject knowledge is no longer sufficient to successfully finish school. Instead, students are to develop so called "competences", which are "learnable cognitive abilities and skills" (Weinert, 2001). These competences enable students to apply their acquired subject knowledge in relevant and complex problem situations.

An example for the implementation of the reform of the Austrian educational system are the new regulations for the final examination for academic upper-secondary schools (called "Matura"). These regulations lay down that examination tasks must contain competence-oriented sub-tasks which require the reproduction as well as the transfer of knowledge and the reflection on knowledge (Bundeskanzleramt Rechtsinformationssystem, 2016). In comparison, traditional examination tasks required the students mainly to reproduce knowledge. Therefore, teachers have to change their examination practice. They are required to develop competence-oriented examination tasks instead of reproduction tasks only.

The Austrian Educational Competence Centre for Biology (AECCbio, https://aeccbio.univie.ac.at) strives to support Austrian biology teachers in order to fulfil the requirements of the new reform. Since 2012, the authors of this paper (biology teachers, teacher educators and science education researchers at the AECCbio) develop, implement and revise a teacher professional development (TPD) course for in-service biology teachers on the development of competence-oriented examination tasks. The overall question guiding our developmental work is: *How can we best support teachers in developing competence-oriented examination tasks?*

The paper presented will introduce our TPD approach and its continued development within the framework of Action Research (Ralle & Eilks, 2002). Currently we analyse examination tasks which have been

developed by in-service teachers after they attended our half-day TPD course. The research questions we want to answer within this paper are: *Which difficulties do teachers have in developing competence-oriented examination tasks? Which support materials and which kind of practical guidance help teachers to overcome these difficulties?*

METHODS

In our TPD courses regarding the development of competence-oriented examination tasks we first worked with in-service teachers during half day face-to-face seminars. We presented the guidelines released by the Austrian Ministry of Education as well as best-practice examples of examination tasks to biology teachers and discussed them. As short-term TPD courses are insufficient to enable teachers to sustainably develop their teaching (Scheuch, 2013), we invited teachers to participate in a joint development initiative: since 2013, the AECCbio invites biology teachers in Austria to participate in the joint development of a pool of competence-oriented examination tasks (Wenzl, Pany, & Heidinger, 2016). In order to get access to the pool, teachers have to submit an examination task they have developed themselves and that meet the requirements of the new guidelines. Members of the AECCbio analyse the electronically submitted tasks and give feedback via e-mail in order to enhance the competence-orientation of the task. Since the new official rules for the final exams require each teacher to prepare several independent tasks, Austrian teachers are very interested in joining the reviewed pool in order to benefit from the work of their colleagues. Up to now, approx. 200 examination tasks were submitted by over 150 biology teachers from all over the country (initially submissions). At present, the task pool contains about 140 reviewed and revised examination tasks fulfilling the requirements of the ministerial directive.

An Action Research approach to course development

Our developmental work is guided by the research framework of Action Research (Ralle & Eilks, 2002). The iterative and pragmatic approach of Action Research allows us to develop TPD courses which are best adapted to teachers' needs. During multiple research cycles our TPD courses are constantly being improved: each research cycle in the development process comprises an action phase (implementation of the TPD course), a reflection phase (based on empirical evidence collected during the course and theoretical considerations) and a phase of further development according to the findings.

Quantitative analysis of teachers' examination tasks

Teachers' initially submitted examination tasks can be understood as empirical evidence regarding the impact of our half-day face-to-face course. Their quality tells us whether the teachers have grasped the idea of competence-oriented task development based on our input. From the reviewing process of the tasks we already know that teachers show great difficulties in developing competence-oriented examination tasks. The current scientific analysis of the initially submitted tasks helps us to verify our first impressions and to get profound knowledge on teachers' difficulties. Therefore, we analyse the examination tasks on a quantitative level using a category system. The categories are derived from the literature on the classification of cognitively challenging learning and assessment tasks which is valid for all subjects (Maier, Kleinknecht, Metz, & Bohl, 2010) as well as specific for science education (Krüger, 2015) and specific for biology education (Jatzwauk, 2008; Crowe & Dirks, 2008). Each sub-task of an examination task is analysed according to the following groups of categories: form of knowledge (facts, concepts, procedures), linguistic features, cognitive processes involved (reproduction, transfer, reflection), authenticity of the problem situation, openness of the task and use of materials. Currently, 100 examination tasks are being categorised. The resulting data are analysed using frequency analysis in SPSS. Inter-rater reliability is calculated for 10% of the tasks.

RESULTS

The preliminary data analysis of 30 examination tasks (N=310 sub-tasks) show that 35% of the sub-tasks require the candidate to reproduce factual and/or conceptual knowledge. 40% of the sub-tasks require a "narrow transfer". These tasks solely demand the extraction of factual and conceptual knowledge from given figures or texts which only requires the reorganisation instead of the application of knowledge in problem situations. Just 17% of the sub-tasks require such a cognitively demanding performance by the candidate,

classified as “far transfer”. Additionally, only 8% of the sub-tasks demand a reflective use of knowledge. Moreover, most of the sub-tasks classified as “far transfer” or “reflection” (82%) place a high demand on reproduction as well. That means that a candidate has to reproduce the necessary facts and concepts first in order to be able to apply this knowledge in the transfer or reflection task. In 72% of the sub-tasks knowledge and procedures do not have to be applied in authentic problem situations. 9% of the sub-tasks offer an artificial and 18% an authentic field of application. The linguistic analysis revealed that in almost half of the cases (48%) the formulation of the task was inappropriate. In most of these cases the wording of the task and what was actually meant widely differs. For instance the verb “discuss” is used when actually reproducing facts is expected, or “interpret the data” is used instead of “analyse the data”.

DISCUSSION

Based on the preliminary data analysis we can already see that teachers experience great difficulties when they develop tasks requiring the candidates to apply their acquired knowledge in complex problem situations. Most tasks solely demand the reproduction or reorganisation of factual and conceptual knowledge within theoretical application contexts. Specific implications for our TPD course model will be considered after the data analysis is finished and will be presented at the conference. The first findings let us assume that we have to provide teachers with more good practice examples of cognitively demanding examination tasks which fulfil the criteria of “far transfer” and “reflection” tasks (e.g., develop a hypothesis or design an experiment, discuss the advantages and disadvantages of a specific biotechnology, etc.).

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