



## Participatory development of competence-oriented examination tasks with biology teachers as large-scale professional development initiative

Ilse Wenzl<sup>1</sup>  
Christine Heidinger<sup>2</sup>  
Peter Pany<sup>3</sup>

<sup>1,2,3</sup>Austrian Competence Centre for Biology, University of Vienna,  
Austria

[ilse.wenzl@univie.ac.at](mailto:ilse.wenzl@univie.ac.at)  
[christine.heidinger@univie.ac.at](mailto:christine.heidinger@univie.ac.at)  
[peter.pany@univie.ac.at](mailto:peter.pany@univie.ac.at)

### Abstract

*International studies of students' performance (e.g., PISA, TIMSS) are decisive in rethinking school-based teaching and learning in many participating countries. These studies conceptualize the ability of students to apply knowledge in meaningful situations as key competence for full participation in society in contrast to the mere reproduction of knowledge. Not least because of the poor performance of Austrian students in PISA and TIMSS, new educational standards were implemented in the Austrian school system. This paradigmatic shift in the educational policy requires a major change in teaching. Teaching and learning should no longer focus on the acquisition and reproduction of subject knowledge but should enable the development of competences, which cannot be taught only by instruction but are developed by dealing with application-oriented tasks.*

*Experience shows that releasing guidelines (by the Austrian Ministry of Education) as well as additional support materials for teachers and short-term teacher professional development courses turn out to be insufficient in supporting teachers to grasp the concept of competence-oriented teaching and learning.*

*Therefore the teachers' platform (a nationwide platform for biology teachers in secondary education) at the Austrian Educational Competence Centre for Biology (AECCbio) offers various professional development courses which help teachers to understand the pedagogical and didactical implications of the educational reform and support teachers in learning how to modify their existing practice according to the requirements of competence-oriented teaching and learning.*

*The paper presented will give an insight in our work with biology teachers regarding the implementation of the educational reform. We will focus on one course segment: courses which prepare teachers for task development for the final examination according to new ministerial guidelines. We will present findings from the process of course (further) development and findings from the investigation of teachers' learning difficulties regarding competence-oriented task development.*

### 1. Introduction

Comparative international studies of students' performance (e.g., PISA, TIMSS) are decisive for rethinking school-based teaching and learning in many participating countries. The disappointing results of Austrian students' performance in PISA 2003 for example led to manifold structural reforms of the Austrian educational system [1]. In order to improve the outcome of formal education, Austria introduced educational standards for all types of schools and all grades. Those standards define learning outcome for each subject and each grade and are conceptualized as sustainably acquired competences by students [2]. The reform of the educational system therefore led to two major changes in the Austrian school system: as up to now school education has been controlled by defining the input (topics that had to be dealt with during school lessons were prescribed via the subject-specific curricula), it came to a shift of attention onto the educational outcome of the school system. Appropriate to the reform teaching and learning should no longer focus on the mere acquisition and reproduction of subject knowledge. Therefore, teachers have to develop challenging learning tasks, where students have to use subject knowledge and skills in order to work on complex real-life tasks instead of solely reproducing facts.



Hence, teachers' ability to create competence-oriented tasks becomes a key ability in the school reform. In order to support teachers in mastering this paradigm shift in teaching and learning, large professional development (TPD) initiatives are launched by the Austrian ministry of education [1]. The teachers' platform (a nationwide platform for biology teachers in secondary education) at the Austrian Educational Competence Centre for Biology (AECCEbio, <https://aeccebio.univie.ac.at>), is part of this initiative. Since 2013, biology teachers and teacher educators at the AECCEbio offer various TPD courses which help teachers to understand the pedagogical and didactical implications of the educational reform and support teachers in learning how to modify their existing practice according to the requirements of competence-oriented teaching and learning.

Our long-term experience shows that teachers have great difficulties to grasp the concept of competence-oriented teaching and learning. The guidelines released by the Austrian Ministry of Education as well as additional support material for teachers (e.g. best-practice examples for competence-oriented tasks) or short-term TPD courses turn out to be insufficient to change teachers' approach according to the requirements of the educational reform.

The paper presented will give an insight in our work with biology teachers during the implementation of the educational reform. We will focus on one segment: courses which prepare teachers for task development for the final examination (called "Matura") according to the new ministerial guidelines. We present findings from the process of course development and from the investigation of teachers' learning difficulties regarding task development.

## 2. Theoretical Background

Competence-oriented examination tasks should make competences that students acquired visible and the evaluation of the reached competence-level possible.

The Austrian examination regulation for academic upper secondary schools [3] requires that examination tasks at the final examination contain competence-oriented subtasks from the performance dimensions "Reproduction", "Transfer" and "Reflexion and Problem solving". "Reproduction"-tasks require the students to remember and reproduce factual and procedural knowledge. Tasks from this performance dimension resemble traditional testing formats teachers are familiar with. "Transfer"-tasks require students to prove their ability to apply the acquired knowledge and skills in new contexts. Therefore students need to analyse the relation of different contexts, select appropriate concepts and theories, etc. [4]. "Reflexion and Problem solving"-tasks require creative performance of students. They have to build up new knowledge by combining existing knowledge in order to find answers to complex problem situations.

The three performance dimensions are operationalised with the help of "Operators" [5]. "Operators" are verbs (e.g. describe, explain, evaluate) which tell the students what is expected in a task and help teachers to pose competence-oriented tasks instead of merely knowledge-reproduction tasks. Lists of different "Operators" for each performance dimension as well as examples for tasks using "Operators" are provided by the Austrian Ministry for Education [5,6]. Using these "Operators" is decisive for teaching in class in order to get students familiar with this new form of posing questions and enable them to show their competences at the final exam.

## 3. Research Questions

Within the framework of Action Research [7] we constantly aim at the improvement of our TPD courses. Our TPD course on examination tasks is focused on the following research questions:

1. Which course formats help teachers to develop competence-oriented examination tasks?
2. Which difficulties do teachers have in developing competence-oriented examination tasks?
3. Which support materials and which kind of practical guidance help teachers to overcome these difficulties?

## 4. Method

Action Research is defined as research carried out by practitioners [7] who aim at improving their teaching practice. In this case, teacher educators are the practitioners and the problem definition and corresponding research questions come from educational work with biology teachers in the TPD courses. Nonetheless, action research demands high methodical accuracy and the linking of the problem definition and findings to available theoretical framework [8].

The main advantage of Action Research in our current research and development project is the iterative and pragmatic approach: experiences gained from TPD courses are collected and reflected based



on empirical and theoretical findings. In a next step the TPD courses are revised according to the new insights and carried out again. Each research cycle in the development process comprises an action phase, a reflection phase and a phase of further development that leads to an improved course design that is best adapted to teachers' needs.

## 5. Results

### 5.1 Which course formats help teachers to develop competence-oriented examination tasks?

Our initial TPD course concept was a half day seminar where the guidelines released by the Austrian Ministry of Education as well as additional material for teachers (e.g. best-practice examples of tasks) were presented to biology teachers and discussed. Afterwards, teachers cooperated in developing and assessing competence-oriented tasks. Reviewing these newly generated examination tasks showed that teachers had great difficulties to grasp the concept of competence-oriented testing.

As this short term TPD course turned out to be insufficient to enable teachers in developing tasks independently, the teachers' platform at the AECCbio launched an initiative to take countermeasures against only short-term TPD courses: the new guidelines for the final examination were used as a motivational force to engage biology teachers from all over Austria in an in-depth dealing with the requirements for competence-oriented task development.

Since 2013, the teachers' platform invites biology teachers in Austria to participate in the joint development of a pool of competence-oriented examination tasks. In order to get access to the pool, teachers have to submit an examination task they developed themselves which needs to meet the requirements of the new guidelines. Members of the teachers' platform at the AECCbio analyse the electronically submitted tasks and give feedback via e-mail in order to enhance the competence-orientation of the task. As the new official rules for the final exams require from each teacher to prepare up to 48 independent tasks, Austrian teachers are very interested in joining the reviewed pool. At the moment, this task pool contains about 140 reviewed examination tasks fulfilling the requirements of the ministerial directive, handed in by over 100 biology teachers from all over the country.

Writing the feedback directly into the text of the tasks turns out to be a useful instrument to improve the quality. The subsequent analysis of the revised tasks shows that the quality effectively improves even after the first round of feedback. The repeated intensive debate on the sources of errors leads in most cases to significantly better results. In addition, while working independently on their own tasks, colleagues develop professional knowledge how to produce high quality examination tasks.

### 5.2 Which difficulties do teachers have in developing competence-oriented examination tasks?

The quality of the submitted tasks varies strongly. When analysing these tasks, several sources of errors turned out to be prevalent: in some tasks, it can be seen that not "Operators" but instead question words (like What, When, How) were used which only address declarative knowledge. Therefore, it is impossible to assign these tasks to one of the three performance dimensions "Reproduction", "Transfer" and "Reflexion and Problem solving". For instance, it was asked "What is the difference between the small intestine and the large intestine?" instead of formulating a competence-oriented question: "Compare the small intestine and the large intestine with regard to anatomic structure and the physiological function."

Another source of error is the use of "Operators". Often they are used in a way that the original meaning of the "Operator" is not comprehensible. In some cases the wording of the task requires other activities than the "Operator" calls for. For example, a comparison or an analysis is required by the "Operator" which cannot be completed with the help of the attached material. Another source of error is the false use of "Operators". For instance "discuss" is used when reproducing facts is expected or "interpret the data" is used instead of "formulate a hypothesis".

A common source of error is the false attribution of subtasks to the three performance dimensions. Very often "Transfer"-tasks entirely miss material, which would help to reduce the demand on the reproduction performance. For example, the task "Compare the transmission of information in excitatory and inhibiting synapses" without offering any diagrams requires from the student to reproduce a high amount of factual knowledge before being able to solve the task. That suggests the assignment of this task rather to the performance dimension "Reproduction" than "Transfer".



### 5.3 Which support materials and which kind of practical guidance help teachers to overcome these difficulties?

In a next step we would like to make explicit the categories used in the review process of the examination tasks. Such a system of categories will be gained from systematically analysis of the existing pool of examination tasks. In addition, the criteria applied in the analysis should refer to didactical theory on cognitive development through competence-oriented tasks [9]. With the help of this system of categories teachers eventually should be enabled to develop competence-oriented tasks themselves.

### References

- [1] Lucyshyn, G.F. & Lucyshyn, J. (2009). Bildungsstandards im Kontext der Implementation und Lehrer/innenbildung. In BiFi Wien (Hrsg.). Konzepte zur Verankerung der Bildungsstandards in Aus- und Fortbildung. Wien. [https://www.bifie.at/system/files/dl/bist\\_konzepte\\_ausbildung\\_2009-01-20.pdf](https://www.bifie.at/system/files/dl/bist_konzepte_ausbildung_2009-01-20.pdf). (accessed 15.01.2016)
- [2] Bundeskanzleramt Rechtsinformationssystem. (2016). Verordnung der Bundesministerin für Unterricht, Kunst und Kultur über Bildungsstandards im Schulwesen StF: BGBl. II Nr. 1/2009. <https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20006166> (accessed 15.01.2016)
- [3] Bundeskanzleramt Rechtsinformationssystem. (2016). Verordnung der Bundesministerin für Unterricht, Kunst und Kultur über die Reifeprüfung in den allgemein bildenden höheren Schulen (Prüfungsordnung AHS) StF: BGBl. II Nr. 174/2012 <https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20007845> (accessed 15.01.2016)
- [4] Bundesministerium für Bildung und Frauen (2014). Mündliche Reifeprüfung AHS. [https://www.bmbf.gv.at/schulen/unterricht/ba/reifepruefung\\_ahs\\_mrp.pdf?4n8n3d](https://www.bmbf.gv.at/schulen/unterricht/ba/reifepruefung_ahs_mrp.pdf?4n8n3d) (accessed 13.01.2016)
- [5] Lahmer, K. (2013). Zur Bedeutung von Operatoren. Wien: E. Dorner. [http://files.dorner-verlag.at/onlineanhaenge/files/zur\\_bedeutung\\_von\\_operatoren\\_0.pdf](http://files.dorner-verlag.at/onlineanhaenge/files/zur_bedeutung_von_operatoren_0.pdf) (15.01.2016)
- [6] Ulf, A. & Saxalber, A. (2013). Typen sprachlichen Handelns („Operatoren“) in der neuen standardisierten schriftlichen Reife- und Diplomprüfung (SRDP) in Deutsch. In BiFi Wien (Hrsg.). [https://www.bifie.at/system/files/dl/srdp\\_de\\_operatoren\\_2013-07-16.pdf](https://www.bifie.at/system/files/dl/srdp_de_operatoren_2013-07-16.pdf). (accessed 15 01 2016)
- [7] Altrichter, H. & Posch, P. (2007). Lehrerinnen und Lehrer erforschen ihren Unterricht (Teachers investigate their work). Bad Heilbrunn: Klinkhardt.
- [8] Scheuch, M. (2013). Die Entwicklung von Pedagogical Content Knowledge (PCK) in Fortbildungen für BiologielehrerInnen. Universität Wien: Wien.
- [9] Maier, U., Kleinknecht, M., Metz, K. & Bohl, T. (2010). Ein allgemeindidaktisches Kategoriensystem zur Analyse des kognitiven Potenzials von Aufgaben. Beiträge zur Lehrerbildung, 28(1), 84–96.