



## What Do Teacher Students Learn in a School-Based Environmental Course?

Marie Eschweiler<sup>1</sup>, Julia Birkholz<sup>2</sup>, Doris Elster<sup>3</sup>

<sup>1, 2, 3</sup> University Bremen, Institute of Biology Education (Germany)

<sup>1</sup>[marie.eschweiler@uni-bremen.de](mailto:marie.eschweiler@uni-bremen.de), <sup>2</sup>[jbirkholz@uni-bremen.de](mailto:jbirkholz@uni-bremen.de), <sup>3</sup>[doris.elster@uni-bremen.de](mailto:doris.elster@uni-bremen.de)

### Abstract

*This qualitative study examines the professional development of primary teacher students regarding their Content Knowledge (CK) and their Pedagogical Content Knowledge (PCK) based on Park & Oliver (2008). The teacher students participate in an academic course to gather content knowledge in environmental education with a specific focus on hibernation of animals and plants. The methodological approach integrates minds-on-activities and hands-on-activities based on the principles of inquiry-based-science-education (IBSE; Elster, 2013). In addition, the teacher students work in teams and develop school projects for 4 to 6 graders, conduct them in the teaching and learning lab of the University Bremen.*

*The study reports first results of the pilot course (N=5 teacher students) that was conducted in winter semester 2014/15 and preliminary findings of the final course that is just running in winter semester 2015/16 (N=25 teacher students). For data collection a questionnaire in the pre-post-design and the students' learning journals are taken to measure the development of PCK and CK. The data analysis is based on the paradigm of the Qualitative Content Analysis (Mayring, 2003).*

*The findings of the pilot course demonstrate an increase of the CK. In addition, the students improve their knowledge about different aspects of PCK, but they struggle with imparting the method of IBSE in their school project. Therefore, in the final course we focus more intensively on the reflection of the essential features of IBSE. First findings of the final course we will report in our presentation.*

### 1. School-Based Environmental Course in Bremen

The course is addressed to primary teacher students of the University of Bremen. At the first stage of the course the teacher students gather content knowledge in environmental education with a specific focus on hibernation of animals and plants. The methodological approach integrates minds-on-activities and hands-on-activities based on the principles of inquiry-based-science-education (IBSE) [1]. In this stage of the course the teacher students investigate several IBSE activities and enhance their understanding about IBSE. At the second stage of the course the teacher students develop school projects in teams for 4 to 6 graders which focus on hibernation of animals and plants and are based on the principles of IBSE. In a final stage the school project is conducted in the teaching and learning lab of the University of Bremen. Five teacher students have participated to the pilot course, which was conducted in winter semester 2014/15. In the final course that is just running in winter semester 2015/16 25 teacher students are attending.

### 2. Our Understanding of IBSE

The course is based on a broad understanding of inquiry-based-science-education (IBSE). We define scientific inquiry as "a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in the light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations and predictions; and communicating the results". Scientific "inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations" by finding answers to questions [2:23].

IBSE "learning is not about memorizing facts – it is about working with living organisms (mainly plants), observing natural phenomena, formulating questions, linking evidence to explanations and finding appropriate solutions to explain observations and address questions and problems. There may be simple tasks or complex undertakings but they will always lead to learners experiencing the excitement of solving a question or problem on their own, usually as part of a team" in a learning community [3:9].

Besides, based on evidences of investigated questions new (pursuing) questions may arise, we represent the essential features of IBSE in a circular-model (Figure 1).

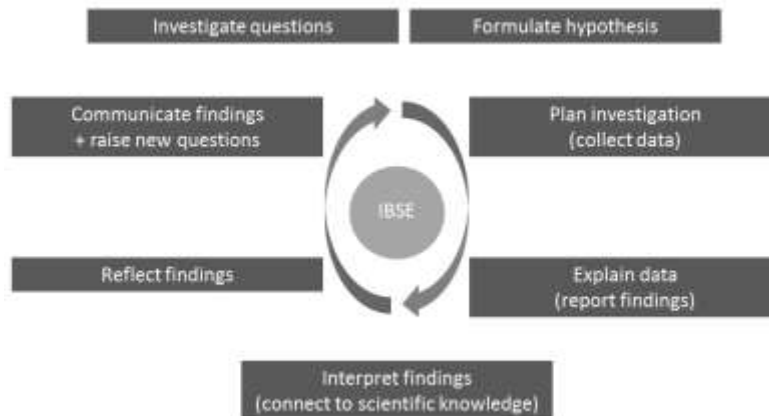


Figure 1. Circular-model of IBSE.

### 3. Professional Development of Teacher Students

The professional development of teachers starts in an early stage of their pre-service teacher training and should continue through their whole working life to ensure their development towards experts in teaching. This qualitative study examines the professional development of primary teacher students regarding their Content Knowledge (CK) and their Pedagogical Content Knowledge (PCK) based on Park & Oliver (2008) [4].

According to Shulman (1986) teachers knowledge is characterized by Content Knowledge (CK - knowing and understanding about the subject content), Pedagogical Content Knowledge (PCK – knowing how to teach content in a comprehensible way) and Pedagogical Knowledge (knowing how to teach more generally) [5]. In this study we focus on the theory of Park and Oliver (2008) which is based on the work of Shulman (1986). They broadened Shulmans theory within a hexagon-model (Figure 2).

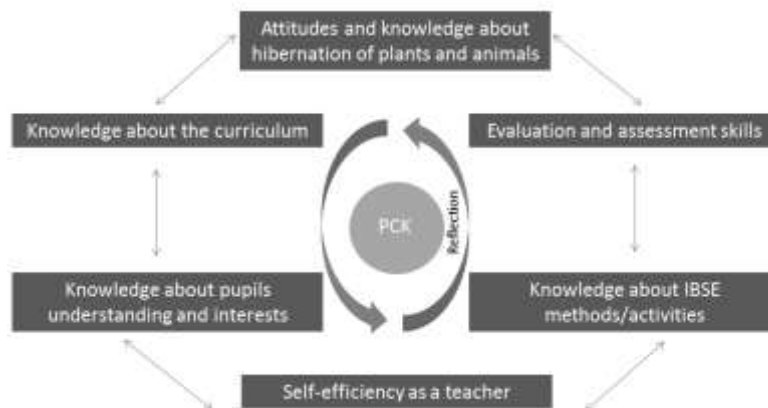


Figure 2. Hexagon-model of Pedagogical Content Knowledge [4, 6; changed]

Data was collected regarding *Knowledge about pupils understanding and interests*, *Reflection* and *Knowledge about IBSE methods/activities*. At this point special attention will be drawn to the component *Knowledge about IBSE methods/activities*.

### 4. Evaluation

The focus of the evaluation lays on the professional development of the student teachers regarding their CK and their PCK [4].

The teacher students reflect throughout the course writing learning journals, wherein they document their own learning progress, their ideas and difficulties regarding IBSE and they assess the presented and self-developed IBSE activities regarding their effectiveness, their existence of all essential features of IBSE as well as their composition (structured, guided, open).



In addition, a questionnaire survey (pre-post-design) is conducted. Moreover, the final course includes reflection conversations. The data analysis is based on the Qualitative Content Analysis [7]. The evaluation of the pilot course has been finished. The analysis of the final course is still in progress, first findings will be reported in our poster-presentation in March 2016 at NPSE. The presented data is based on the findings from the pilot course.

## 5. Findings and Conclusions

### 5.1 Content Knowledge

The findings of the pilot course demonstrate an increase of the CK and therefore indicate that the teacher students can enlarge their professional development regarding this domain of knowledge. Based on the questionnaire we indicate that the teacher students already had previous knowledge to varying degrees about hibernation of animals and plants. During the course the teacher students gained a detailed view on this topic as the analysis of data revealed.

### 5.2 Pedagogical Content Knowledge

In addition, the teacher students improved their knowledge about different aspects of PCK. The findings demonstrate an increase of *Knowledge about pupils understanding and interests*, *Reflection* and *Knowledge about IBSE methods/activities*.

The results regarding the component *Knowledge about IBSE methods/activities* are explained in more detail:

Based on the results of the questionnaire (pre-post) we identified a little increase about the theoretical knowledge about IBSE. However, the teacher students' answers do not verify precisely and intensively in-depth examination of the topic. Moreover they struggle with imparting the method of IBSE in their school project. The developed IBSE activities do not consider all essential features of IBSE.

The findings indicate that the teacher students' limited understanding about IBSE carried out that they cannot integrate it successfully in their teaching lessons.

Additionally, it should be emphasized that the student teachers' willingness to integrate this method in their school lessons in future and their self-estimation of IBSE competences both arose during this course. Furthermore the teacher students describe IBSE approaches as an effective method for scientific school lessons. It is to be hoped therefore that the students acquire the skills necessarily to implement IBSE successfully in future throughout their careers as a result of practical experiences.

In the final course we focus more intensively on the reflection of the essential features of IBSE. The final course integrates from now on reflection conversations in order to detect difficulties regarding IBSE at an early stage and to promote the professional development regarding the PCK component *Knowledge about IBSE methods/activities* more precisely in future.

## References

- [1] Elster, D. (2013). "Inquire for Students" – How to Promote Inquiry Based Learning? In: Conference Proceedings. New Perspectives in Science Education 2013. Florence, Italy: Libreriauniversitaria.it, 337-341.
- [2] NRC (National Research Council) (1996). National Science Education Standards. Washington, DC: National Academy Press.
- [3] INQUIRE (2011). Pilot INQUIRE Course Manual for teachers and educators. Kew, London, UK: Royal Botanic Gardens. <http://www.inquirebotany.org/en/resources/kew-pilot-inquire-course-manual-128.html> [download December 20th, 2015]
- [4] Park, S. & Oliver, J. S. (2008). Revisiting the Conceptualisation of Pedagogical Content Knowledge (PCK): PCK as a Conceptual Tool to Understand Teachers as Professionals. *Research in Science Education*, 38(3), 261-284.
- [5] Shulman, L.S. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher*, 15(2), 4-14.
- [6] Elster, D., Barendziak, T., Haskamp, F. & Kastenzholz, L. (2013). INQUIRE for Teacher Students - Case Study University of Bremen. <http://www.inquirebotany.org/en/resources/kew-pilot-inquire-course-manual-128.html> [download December 14th, 2015]
- [7] Mayring, P. (2003). *Qualitative Inhaltsanalyse. Grundlagen und Techniken* (8. Aufl.). Weinheim: Beltz Verlag.