(Germany) / Klagenfurt: Alpen-Adria-Universität Klagenfurt (Austria).

Slovinsky, E. (2012). SALiS and educational policy in Georgia. *Proceedings of the Student Active learning in Science Final Conference* (pp. 101–102), Tbilisi.

Teacher's Professional Development Center. (2012). *Science teacher's standards*. Tbilisi, TPDC.

4.7 Teachers' Ownership towards Developing New PROFILES Modules

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Abstract

PROFILES aims at developing teacher professionalism, enhancing teacher self–efficacy and promoting teacher evidence-based ownership of PROFILES ideas and innovative practices. Two rounds of PROFILES continuous professional development were conducted in Georgia during 2013–2014. Six new and four adapted modules were implemented in Georgian Schools. New modules are discussed for development of a sense of teachers' ownership of the PROFILES approach during the workshops and implementation of the project.

Introduction

The Goal of Science education is to enhance students' scientific literacy. Students' motivation plays an important role in their conceptual change processes, critical thinking and science learning achievement in enhancing scientific literacy (Tuan, Chin & Sheh, 2005).

PROFILES, devised to give teachers self-efficacy, and for some, ownership of the PROFILES approach to the teaching of science subjects, strives to enhance the scientific literacy of students. Through a PROFILES CPD model, partners aim to develop teachers' competences in a way that they are able to work with their students in improving their specific skills such as decision-making, asking questions, problem solving, argumentation, etc. (PROFILES, 2010)

Two rounds of the PROFILES CPD programme were conducted in Georgia, in which 40 science teachers from different towns participated. During these programmes, the CPD providers worked with the teachers, amongst a variety of teacher needs, on IBSE techniques and the development of different modules in Physics, Chemistry and Biology. Georgian teachers were very motivated and worked with great interest.

PROFILES promotes the professional development of teachers in four specific components – teacher as a learner, teacher as an effective teacher, teacher as a reflective practitioner and, for some, teacher as a leader.

As suggested by the leaders of WP5 (Hofstein & Mamlok-Naaman, 2012), in order to develop a sense of ownership of the PROFILES approach among teachers, it was considered important to develop two initial and basic components of the four components of the CPD model used in PROFILES, namely teachers as learners and as teachers in the classroom. These two components were visible during the CPD programmes in Georgia. In the 3rd component – teacher as a reflective practitioner, a sense of ownership started to be developed in the teacher's mind.

For the development of teacher ownership of the PROFILES approach during the CPD courses, the model used was proposed by Loucks-Horsley, Stiles and Hewson (1996). Based on this model an image of effective classroom learning and teaching was defined, which emphasized inquiry-based learning in conducting students' investigations and the application of knowledge. During the CPD, science teachers were provided with opportunities to develop their science knowledge and teaching skills for creating better learning opportunities for

the students and in supporting them to take on leadership roles, if they were inclined to do so.

During the CPD workshops, Georgian teachers became familiar with the rationale and purpose of the PROFILES project. The importance of motivation through the use of student centered strategies was emphasized. Teachers were led to understand the significance of education through science and why inquiry is put forward as an integral part of this, alongside teacher motivational techniques, context-based teaching approaches and the involvement of students in socio-scientific decision-making via the PROFILES 3-stage model. Teachers chose the relevant contexts for their students and they either used already suggested modules from PROFILES partners, or created their own within the suggested PROFILES frame.

The PROFILES approach to stimulate students' motivation for learning in science lessons is based on several issues, one of them is – teaching, initiated by means of a real scenario (PROFILES, 2010). All PROFILES modules, developed and implemented in Georgia are based on real socio-scientific issues.

New PROFILES modules

Cheese making: which to use – modern technology or nature's way?

This module is created by Natia Bagatrishvili, Biology teacher from Telavi State School N7. The story is based on a real issue following a student visit to her grandmother in a village when seeing a flask with very interesting material in it – this was the abomasums of young calves which are to be put into whey, together with some salt and vinegar, as well as beans, wheat and corn seeds. Students derived the answer that this material was for the cheese making in a natural way and they decided to investigate cheese production technology.

The main scientific inquiry question for this module – what are the factors affecting the production of cheese starting from milk?

After the students formulated different hypothesis, one group started to investigate the effect of temperature on cheese production. Another group investigated the influence of the quality of milk and the nature of enzymes.

They conducted different experiments to study the process. During the module implementation, new questions were raised such as:

(a) Why must the abomasums be dried?
(b) What will be the result if we take the abomasums, not from young calves, but from cows, sheep or pigs?
(c) Why is the abomasums put in vinegar? What is the role of beans, wheat or corn put in the liquid?
(d) If we take the pepsin, obtained in a synthetic way, what will be the results?

Picture 1 & 2. Cheese making module

Implementation – 4 lessons.

After implementation, students made conclusions and gave answers to the main question. In addition students found out the information about the history of cheese production in Georgia. They prepared an article about cheese production for the newspaper.

This module will be disseminated in Kakheti region to about 50 teachers soon.

What material keeps information for a long time?

The module is created by Irma Avaliani, Biology teacher at GLC school, Tbilisi.

The story is based on a real issue when the students who were participating in an intellectual

game couldn't answer the question "What is it? It remained stable for 42 000 years in the cold Siberian tundra, answering the secret of Napoleon's death, defended suspected persons in their use of narcotics." Students made hypothesis about the content of the material, found out the information and formulated several questions about the stability of proteins.

The main scientific inquiry question for this module was put forward as – have all proteins the same stability? Students formulated their hypotheses about the stability of different proteins and started to investigate it.

Implementation – 4 lessons. Experiments were conducted with the proteins from egg, muscle and hair. Conditions for denaturation were investigated. The stability of the proteins was identified. Students read several scientific articles.

Students found out that the most stable protein is hair protein, this being called Keratin.

Picture 3. Protein stability

Innovations of this module:

- For students to put forward the question for investigation themselves
- Students are able to compare different proteins' properties during one experiment
- Students are able to conduct theoretical and experimental investigations
- Students are able to formulate new investigation questions

At the end of this module students prepared an article about proteins for the newspaper.

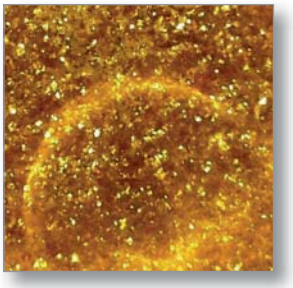
Is all that shines gold?

The module is created by Rusudan Ustiashvili, Chemistry teacher at school ''Opiza''.

The story is based on a real issue when students saw how people in mountains were extracting gold from the mountain river using an old traditional Georgian method. This raised the question in the student's mind as to whether all that shines is gold and how could they investigate this aspect.

Students searched and found information about alchemists and decided to attempt to produce gold in the laboratory.

Students conducted different experiments with KI and $(CH_3COO)_2Pb$ – one of the recipes they found from the literature. The students found they could produce a gold-like substance. But was it gold! They formulated their own hypothesis about the content of this substance and put forward reasons in support of their hypothesis. They planned different tests to find out whether this substance had the properties of gold.



Picture 4 & 5. Module „Is all that shines gold?"

Unfortunately (but without too much disappointment as the students enjoyed the investigation), after the chemical investigations they concluded that this substance wasn't gold.

Implementation – 3 lessons.

Why cans of Coca Cola sink and cans of Coca Cola Zero float

This module is created by a group of teachers, who used Freie Universität Berlin materials from the project SALiS (Streller, Hoffmann & Bolte, 2011; Streller, 2012).

The story is based on a real issue when students, during an excursion, wanted to get cold drinks by using cold water from the river. But they found out that after putting Coca Cola in a river, cans of normal Coca Cola sank in the river while cans of Coca Cola Zero floated.

Students investigated the content of both drinks, predicted the possible reason for the heavier coca cola (and predicted this is about density differences), constructed graphs and made conclusions about the sugar content of these drinks (being the cause of the change of density).

After reaching their conclusions, the students discussed about a healthy style of life and healthy drinks and prepared some recommendations.

Implementation – 4 lessons.

Why jam, confiture and salted products aren't spoiled over a long period of time?

This module is created by Marina Bagalishvili, Biology teacher at Tbilisi state school N 145.

The story is based on a real issue when the boy asked his elder brother why they only need the refrigerator for keeping some food products?

Picture 6. Storage life module

The main scientific inquiry question for this module – what is the reason that some sugared and salted products aren't spoiled for a long time?

Students formulated their hypothesis about the effect of sugar and salt on the storage of different products. Students conducted different experiments and studied the phenomena of osmosis and plasmolysis, linking these with conditions needed for the storage of foods. They investigated also the conditions for the spoiling process. Students used onion, apple and carrot for their investigations.

Implementation – 5 lessons.

All modules are developed and based on the PROFILES 3-stage model (Bolte et al., 2012):

1. Issues connected with everyday life;
2. Student-centered emphasis on scientific problem solving; (This is stage 2 of the 3-stage model)
3. Including socio-scientific decision-making to relate the science acquired to societal needs for responsible citizenship. (This is stage 3 and comes after the investigation in part 2.)

Teachers and students guides were created for all modules.

PROFILES modules enable students to gain a conceptualization of the nature of science and apply it in reflecting on the teaching undertaken in socio-scientific daily decision-making driven teaching approach where students are expected to put forward ideas, show creative thinking, develop self-determination, self-management skills and undertake self-evaluation.

Summary

Based on teacher feedback, it can be stated that PROFILES modules were successfully implemented in Georgian schools.

Teachers reported after the implementation about:

1. The enhancement of students' motivation and interest in science.
2. The students' feeling of achieving success in learning science.
3. Improvement of students' scientific, social and organizational skills.
4. Students' ability to ask questions and to

plan new experimental investigations.
5. Students' decision-making related to socio-scientific issues.
6. Students' argumentation skills in making consensus decisions.
7. Students' satisfaction with learning science.

Teachers who participated in PROFILES CPD developed, in themselves, creativity and experimental skills and gained new ideas and perspectives on science education. Many of them changed their teaching style and focused more on an inquiry-based approach. They learned a lot from each other by working together.

Based on teachers' feedback, it is clear that implementation of PROFILES modules contributed to the development of students' scientific literacy.

References

Bolte, C., Streller, S., Holbrook, J., Rannikmäe, M., Hofstein, A., Mamlok-Naaman, R., & Rauch, F. (2012). Introduction into the PROFILES Project and its Philosophy. In C. Bolte, J. Holbrook, & F. Rauch (Eds.), *Inquiry-based Science Education in Europe: Reflections from the PROFILES Project* (pp. 31–42). Berlin: Freie Universität Berlin (Germany) / Klagenfurt: Alpen-Adria-Universität Klagenfurt (Austria).

Hofstein, A., & Mamlok-Naaman, R. (2012). Teachers' Ownership: What Is it and How Is it Developed? In C. Bolte, J. Holbrook & F. Rauch (Eds.), *Inquiry-based Science Education in Europe: Reflections from the PROFILES Project* (pp. 56–58). Berlin: Freie Universität Berlin (Germany) / Klagenfurt: Alpen-Adria-Universität Klagenfurt (Austria).

Loucks-Horsley, S., Stiles, K., & Hewson, P. (1996). Principles of Effective Professional motivation towards science learning. *International Journal of Science NISE Brief 1*(1). Madison, WI: University of Wisconsin.

Streller, S., Hoffmann, M., & Bolte, C. (2011). "Cola and Diet Cola" – a SALiS module for science lessons. FUB: Berlin. Retrieved from (in Georgian Language): http://www.idn.uni-bremen.de/chemiedidaktik/salis_zusatz/material_pdf/book_experiments_%20georgia.pdf (15.07.2014).

Streller, S. (2012). Experiencing inquiry learning. *Chemistry in Action! 97,* 18–22.

Tuan, H.-L., Chin, C.-C., & Shieh, S.-H. (2005). The development of a questionnaire to measure students' motivation towards science learning. *International Journal of Science Education, 27*(6), 634–659.

4.8 See You Later 'Navigator' – PROFILES Type Learning Environments with Special Emphasis on Occupational Orientation and the Evaluation of Their Impact on Students' Attitudes

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Abstract

Several studies point out that there is a lack of young people choosing careers in the sciences. Therefore, to enlighten young people about the opportunities and challenges the sciences are offering becomes more and more a major task of societies in general and of science education in particular. Our contribution focus on the conception and evaluation of a PROFILES project called "Career and Science Navigator (CSN)" (in German: "Berufe-NaWigator") created and conducted by a PROFILES working group at Freie Universität Berlin (FUB). The CSN project includes the conception of an IBSE oriented model for teaching and learning science and its empirically tested coherence as well as the development and realization of a sequence of lessons based on this model for science instruction and the evaluation of this PROFILES type learning arrangement which concentrates on connecting science education with occupational orientation in