2.5 PROFILES Modules in the Slovenian Context

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Abstract

Teaching science is challenging in the modern society especially because a lot of students are not intrinsically motivated for learning science. This means that teachers should undergo professional changes to make students believe that scientific knowledge that is determined by the national curriculum is useful for their future life even if they are not going to be in a profession tightly connected with science. These problems facing by teachers and also by students in the school science classroom can be at least partly solved by implementations of different educational strategies that can promote students science learning. One of such strategy that is applied across European countries is PROFILES teaching and learning science approach. Teachers need to use specific PROFILES teaching and learning modules while implementing PROFILES approach. This chapter illustrates Slovenian perspective to development of PROFILES modules.

Introduction

The PROFILES project promotes IBSE (Inquiry-based Science Education) – as the first of a number of innovations in the PROFILES teaching and learning science approach – through raising science teachers’ self-efficacy, promoting a better understanding of changes in teaching science in schools and identifying the value of stakeholder networking. Initially, PROFILES involved the development of teachers on four fronts – teacher as learner, as teacher, as reflective practitioner and as leader (Hofstein & Mamlok-Naaman, 2012) – further consolidating ownership of the context-led approach by incorporating use-inspired research, evaluative methods and stakeholder networking.

The PROFILES project focuses on students’ motivation for science learning, both in terms of intrinsic motivation (relevance, meaningfulness, as assessed by the students) and extrinsic motivation (teacher encouragement and reinforcement) and attempts to make school science content more meaningful (Devetak, Vogrinc & Glāžar, 2011; Bolte et al., 2011; Bolte & Holbrook, 2012). This interest for science learning can be stimulated by basing the initial teaching on a socio-scientific contextual issue – second innovation of the PROFILES teaching and learning science approach. At the end of the learning through a particular unit, students are involved in determined an appropriate and justified decision about the presented socio-scientific issue by using the science learning obtained in the central (IBSE) part of the science learning in the unit. This is a third innovative aspect presented by the PROFILES learning and teaching science approach.

Teaching science is challenging in the modern society, especially because many students are not intrinsically motivated for learning science. They do not see the relevance of the traditional science knowledge for their future lives. Supporting teachers in this endeavour suggest that teachers undergo continuous professional development (CPD) in adequately designed programmes.

It is important for students to understand and to be aware of the usefulness of basic science knowledge for their future life when they will be responsible for solving specific problems and taking the right decisions in a range of occupational fields (cleaning, cooking, environmental issues, agriculture, medical decisions, transportation etc.), even if they are not going to be professionally connected with science. These problems facing teachers and also students in the school science classroom can be at least partly solved by implementation of different educational strategies that can promote students’ science learning. One such strategy is the PROFILES teaching and learning science approach, in which teachers use specific PROFILES teaching and learning modules while implementing the PROFILES approach. A self-awareness and ownership of the PROFILES innovation is a target of the CPD programme where teachers are involved in the use of specially designed teaching and learning modules.
**PROFILES modules development**

Initially, PROFILES CPD involves the development of teachers on four fronts (teacher as learner, as teacher, as reflective practitioner and as leader), developing their self-efficacy in the context-led approach. In the school year 2011/12, 41 teachers (35 from primary school, 6 from secondary school and 14 pre-service teachers) and in the school year 2012/13 29 teachers (all from primary school) were actively involved in the PROFILES CPD programme in Slovenia. 11 teachers participated in both rounds of CPD – these teachers were considered to be ‘leading’ teachers, because they were also actively evolved in offering professional support to the novice teachers in the second round of the PROFILES CPD programme. At least one of the ‘leading’ teachers was assigned to each group.

In both rounds of CPD programme teachers were divided into groups according to their teaching level and according to the subject they teach (biology, chemistry, or physics). A consultant (a member of the national PROFILES team) was also assigned to each group of teachers and each group selected its ‘leading’ teacher. Each consultant was in constant contact with the ‘leading’ teacher, who then disseminated important information to the other teachers in the group. With the consultants’ and ‘leading’ teacher support, the teachers as part of their professional development developed three PROFILES modules in each group.

The collaboration between researchers and teachers in the PROFILES project can be summarized in four crucial steps, which are presented in Figure 1 (Wissiak Grm & Ferk Savec, in press).

Further information about teacher professional development programme in Slovenia is given in the article in this book by Devetak and Vogrinc (2013).

**PROFILES modules structure in Slovenian context**

Teachers in each group developed PROFILES modules according to the PROFILES philosophy (Rannikmäe & Holbrook, 2012), with elements of Guided Active Learning in Chemistry (GALC) strategy (Devetak, Vogrinc & Glažar, 2011; Kolbl & Devetak, 2012), with consultants supporting the whole process. The GALC strategy was upgraded by the philosophy of the PROFILES project and the approach was applicable not only to chemistry but also for biology, physics and science education. Applying GALC learning strategy to science content was intended to raise students’ awareness of:

1. their preferred mode of learning and of their learning strengths;
2. their prime motivators and self-confidence to succeed;
3. the issues they should consider, such as the significance of water, nutrition, sleep and a positive learning environment;

![Figure 1. Crucial steps of collaboration between researchers and teachers in the PROFILES project](image-url)
(4) some of the specific strategies they can use, for example, to stimulate their memory or to make sense of complex information, and (5) some of the habits they should develop, such as reflecting on their learning, so as to achieve improvement in future.

The GALC ideas are based on developments in cognitive learning theories and classroom research show that students generally experience improvements in learning when they are engaged in classroom activities that encourage developing their own knowledge following a learning cycle (Farrell, Moog, & Spencer, 1999). Students need to work together, not only because of their preparation for team work (in science and most of the professions), but because they learn better through social interactions. Students should reach their own conclusions and not be called upon to verify, for example, what the textbook or instructor has indicated to be the expected result of the experiment. The student must be an active learner (Hanson & Wolfskill, 2000).

In turn, the GALC approach was based on the POGIL (Process Oriented Guided Inquiry Learning) pedagogical method, the purpose of which was to teach process skills (such as collaboration and written expression) as well as the content using the inquiry-based approach (Farrell, Moog & Spencer, 1999; Minderhout & Loertscher, 2007). This approach is usually applied according to the theories on cooperative and collaborative learning. POGIL and GALC are both based on the guided inquiry approach to learning and on the constructivist principle; i.e. it is assumed that students learn better if:

1. they are actively engaged and thinking in the classroom;
2. they develop knowledge and reach conclusions themselves by analyzing the data and discussing ideas;
3. they learn how to understand concepts and solve problems together;
4. the teacher adopts the role of facilitator to assist groups in the learning process; and
5. where the teacher does not provide answers to any questions, so that the students are reasonably expected to provide answers themselves (Farrell et al., 1999).

The difference between GALC and POGIL is in the organization and adaptation of the POGIL method to the Slovenian 45-minute periods of lessons and to the PROFILES philosophy. The GALC/PROFILES learning modules can be used by the teacher in the classroom during one learning period (or more) and can be adapted to serve the teacher according to the standards and competences set by the national curriculum. The experimental work, which is incorporated into the GALC/PROFILES modules, is also a further difference between GALC/PROFILES modules and POGIL learning units.

The GALC/PROFILES learning modules have their specific sections, which follow consecutively and guide the student through the learning module. At the end of each learning module, the students are expected to be able to solve problems in connection with the learning. Each learning module has a title which is expressed as a problem question, mostly referring to the concrete environmental, or socio-scientific situation, with which students are more or less familiar.

In the next stage, when students have realised the purpose for studying the particular chemistry learning content and for understanding the embedded concepts. In the section Why do I have to learn this?, an environmental or socio-scientific issue is presented in more detail. Thus, this part deals with the content of the learning module in a wider context, implying plausible answers to the question posed in the title. The text of this part is purposely designed to be interesting for the students in order to stimulate their motivation to delve further into the learning module. The sections Learning goals and Learning outcomes are placed prior to the concrete activities, which students are to pursue, before they reach the set goals of a particular learning unit. A further three initial sections cover:

1. Prerequisites composed of the very concepts and learning contents, respectively, which are crucial for the students to understand new concepts, models and data;
2. Additional resources provide some additional
literature and sources in which students can find additional information on the discussed learning content of the module; and

(3) New concepts that students will be presented within the learning module.

In the **Information and Models** section, groups of students begin with learning new material (careful reading and discussing the material). In this part of the learning module the learning content is presented and some activities regarding IBSE are introduced. The answers to the **Key questions** comprise the very pieces of information which are provided in the **Information and Models** chapter, thus again leading the students to more detailed reading and mutual discussion on the topic. When looking for answers to the key questions the students analyze the data and establish connections among them and evaluate the syntheses. By doing this, the students reach higher cognitive levels themselves. This aspect is the lowest level of task solving, because students are more or less expected to mainly reproduce data.

The gathered knowledge of the specific learning content is afterwards applied by students at solving more simple tasks in the **Exercises** chapter. This work contributes to developing the students’ self-confidence in applying new knowledge. The **Exercises** chapter is upgraded with the **Do I understand** chapter, in which students provide answers to a series of questions, thereby adding to their knowledge and establishing their comprehension of the learning module material. This part is mainly devoted to the metacognitive process and continues with the last, most demanding learning stage, i.e. problem-solving tasks.

The last stage is devoted to the **Problems** chapter, in which students solve the posed problem task by applying synthesis and evaluation of the acquired knowledge, transfer of the knowledge to the new context and specific strategies on the basis of IBSE that should be used. The process of learning sequences in GALC/PROFILES module is presented on Figure 2.

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**Figure 2. General structure of the PROFILES module and the process of active-cooperative learning sequences.**
Each PROFILES module was designed for students to learn science concepts collaboratively. This means that students have roles to follow set by the PROFILES modules. The module presented below entitled “Should athletes undertake high altitude training?” is slightly modified, because it emphasises the teachers’ role in presenting the new concepts (see at: http://www2.pef.uni-lj.si/kemija/profiles/english.html). For that reason all the concept explanations regarding circulatory system was transferred into the Teachers note. Originally, these concepts were situated in the Information and models part of the students’ activities, because students were expected to read and learn cooperatively these new concepts and teacher just had a leading role.

But in the PROFILES strategy, teachers can also have a more active role explaining the new concepts and for that reason information about the new concept is not needed in the students’ activity sheets.

Student activities cover all three stages of the PROFILES model. This means that students should read for themselves a motivational socio-scientific problem that involves interesting topics from students’ lives. After that students perform numerous tasks in the context of IBSE and at the end they solve the decision-making problem that refers to the socio-scientific issue at the beginning of the module. Before decision-making, students answer consolidation questions where they repeat and try to understand the knowledge presented in the module.

The teacher guide comprises general and specific information about the nature of the PROFILES modules. Teachers become familiar with the modules’ learning expectations, what are learning outcomes by lesson, what are the competences students have to achieve and how they do this.

The third part in the module is a part where teachers get information about suggested assessment by:

1. assessing based on skills acquired comprising social values, personal skills, and using science method,
2. assessment by lessons, and
3. assessment based on teacher strategy i.e. assessment tool based on the teacher’s marking of written material and assessment tool based on the teacher observations.

Each module concludes with the teachers’ notes, where some suggestions for experimental work are presented, possible answers to the consolidating questions are suggested and additional information for teaching the topic are illustrated.

**PROFILES modules implementation**

In all of the teacher groups, two or three modules (3–6 school lessons each) were applied in the school environment/practice. The MoLE questionnaire was used at the beginning and at the end of each module application. Data from these questionnaires were/was electronically gathered to evaluate students’ attitudes and level of motivation for learning science. Each group of teachers also developed paper-pencil pre-knowledge and post-knowledge test that were applied to evaluate students’ knowledge achievements.

All teachers, if they had the opportunity in the school, taught the same topic as it was presented in PROFILES modules, in their own traditional manner of teaching; by using the same teaching methods as usually in presenting the selected to the students (control group).

‘Leading’ teachers developed PROFILES modules will be implemented using a pre-post research design in the school year 2013/14. The preliminary research results from cognitive and motivational aspects indicate that the pupils needed some time to adjust to the PROFILES approach, which then eventually contributed to their better achievements in chemistry (Šket et al., 2012; Ferk Savec & Devetak, in press). Further data, obtained in the process of PROFILES modules implementation, will be presented in future publications.
Conclusions

In order to address the challenges of teaching science in modern society, across European countries PROFILES teaching and learning science approach has been implemented.

Students who are exposed to working with the PROFILES learning modules tend to delve into the contents if they can actively participate in the learning process more profoundly and they also understand them better, thereby contemplating about the content to be studied and learning to work in a team. Their knowledge is developed by the data analysis and the discussion on ideas pertaining to the learning content. Attention is also paid to written and verbal communication and to team work. Consequently, the individual concepts within the content are easier to understand, and students also develop problem-solving abilities based on the IBSE approaches. Team work in which research methods are applied, motivating students and enabling the teacher to be provided with immediate and permanent feedback on the students’ understanding of the discussed concepts.

The metacognitive process is crucial in the PROFILES approach to teaching science, enabling the students to be aware of the learning process through self-reflection, self-evaluation, self-planning and self-regulation of the educational process. In this process the teacher’s role is only to be a facilitator, providing assistance to the students in the learning process. The prime goal of implementation of the PROFILES strategy in the science lessons is to encourage students to build up their knowledge within a social learning context in a guided manner through discussion and IBSE strategies and to attend to more or less demanding tasks (Devetak & Glažar, 2010).

After the process of PROFILES modules development and optimization, the modules were implemented in school classrooms. Thereby, classes in which PROFILES modules were implemented were regarded as experimental groups, while the other classes, in which teachers taught their students in their usual way, were regarded as control groups. During the intervention in school practice also pre-post research design was used to assess students’ knowledge gain in the experimental group alone, and MOLE questionnaires were completed prior and after each of the modules to follow motivational aspects of students’ learning. The preliminary research results from cognitive and motivational aspects indicate that in some subject and some topics using the PROFILES approach, students achieve significantly better results in comparison to the traditional ways of teaching.

References


Devetak, I., Vogrinc, J., & Glažar, S. A. (2011). Guided active learning in chemistry modules used in


