4.6 Inquiry-based Science Education within the Project PROFILES in Georgia

Marika Kapanadze & Ekaterine Slovinsky – Ilia State University, Georgia

Abstract

Ilia State University became a project consortium member in January 2013. All activities due to project proposal have been planned and implemented in Georgia during 2013–2014. Continuous Professional Development for the teachers, Delphi Study, Students Gains, Teachers attitudes about the implementation of IBSE – all these activities and studies have been undertaken in Georgia. The article indicates the outcomes of the PROFILES project in Georgia.

Introduction

Results of the Relevance of Science Education Study (Schreiner & Sjøberg, 2004) illustrate that students in many countries have little interest in science and in learning science. To cause a change, different reports (National Research Council, 2000; Rocard et al., 2007) suggest that Inquiry-based Science Education (IBSE) might be an innovative approach to enhance motivation and learning outcomes.

National educational reforms in Georgia began in 2004. Since 2004, several versions of a new national curriculum for both elementary and secondary schools were piloted and implemented. Much attention was paid to developments within the new science curricula, which acknowledge a more inquiry-based and student-oriented approach (Kapanadze, Janashia & Eilks, 2010; Slovinsky, 2012).

The new textbooks appeared in Georgian Schools, but teachers aren't prepared to follow the process. The schools aren't equipped accordingly and the teachers do not possess the skills to conduct the learning process according to curricula.

One consequence of the reform was a focus on the standards and syllabi pertaining to science teacher education. In Georgia, new standards for science teachers were developed and approved (Teacher's Professional Development Center, 2012). These specified the specific competencies required of the science teachers, which should allow them to effectively achieve the desired outcomes defined in the National Curriculum. 'Teachers House', which was responsible for teacher training in Georgia, organized centralized short term training.

The reform is ongoing, but the low quality of science teaching in schools and its impact on the students' motivation is often highlighted during meetings and national conferences in Georgia.

Educational projects, such as PROFILES (Professional Reflection-Oriented Focus on Inquiry-based Learning and Education through Science) support the enhancement of motivation and also disseminating the IBSE approach in Europe (Bolte, Holbrook & Rauch, 2012).

Ilia State University (ISU) is one of the major universities in Georgia with pre-service and in-service teacher preparation programmes. ISU became an official member of the PROFILES science consortium in January 2013.

Continuous professional development (CPD), teacher ownership and new PROFILES modules

Two rounds of Teacher Professional Development with 40 teachers were held since January, 2013. Participant teachers were from different parts of Georgia. The duration for each CPD round was 50 contact hours. The professional development was oriented to enhancing the skills of teachers. During the workshops, creative thinking, problem solving and designing socio-scientific learning environment were supporting by the providers. Based on 3-stage model, the philosophy of PROFILES was introduced

to participants of the CPD.

Teachers selected materials (teaching modules) from the project web page (PROFILES, 2010), or they designed modules by themselves. During these two rounds, six new and four already tested modules by PROFILES and PARSEL Consortium members were implemented in Georgian schools, involving 24 state and 10 private Georgian schools.

PROFILES promotes the professional development of teachers at four specific level – teacher as a learner, teacher as teacher, teacher as reflective practitioner and teacher as a leader.

As it is suggested by leaders of the WP5 (Bolte, Holbrook & Rauch, 2012; PROFILES, 2010), in order to develop a sense of ownership among teachers, it is important to develop two initial and basic components of the four component CPD model used in PROFILES, teachers as learners and teacher as teacher. These are promoted during our CPD programmes. At the 3rd stage – teacher as a reflective practitioner – a sense of ownership of PROFILES project starts to be developed in the teacher's mind. This sense of ownership is observed among the participating teachers (Hofstein & Mamlok-Naaman, 2012).

Professional development regarding stages of concern towards inquiry-based science education

The aim of the CPD training and the work with PROFILES modules is to encourage in-service teachers to implement IBSE and education through science in their schools and integrate the approach into their teaching practice (Bolte, Holbrook & Rauch, 2012; PROFILES, 2010). In order to evaluate the impact of the provided CPD programme, we analyze teachers' attitudes about their profession.

To gain insights into in-service teachers' attitudes about the implementation of IBSE and education through science, we refer to the "Stages of Concern

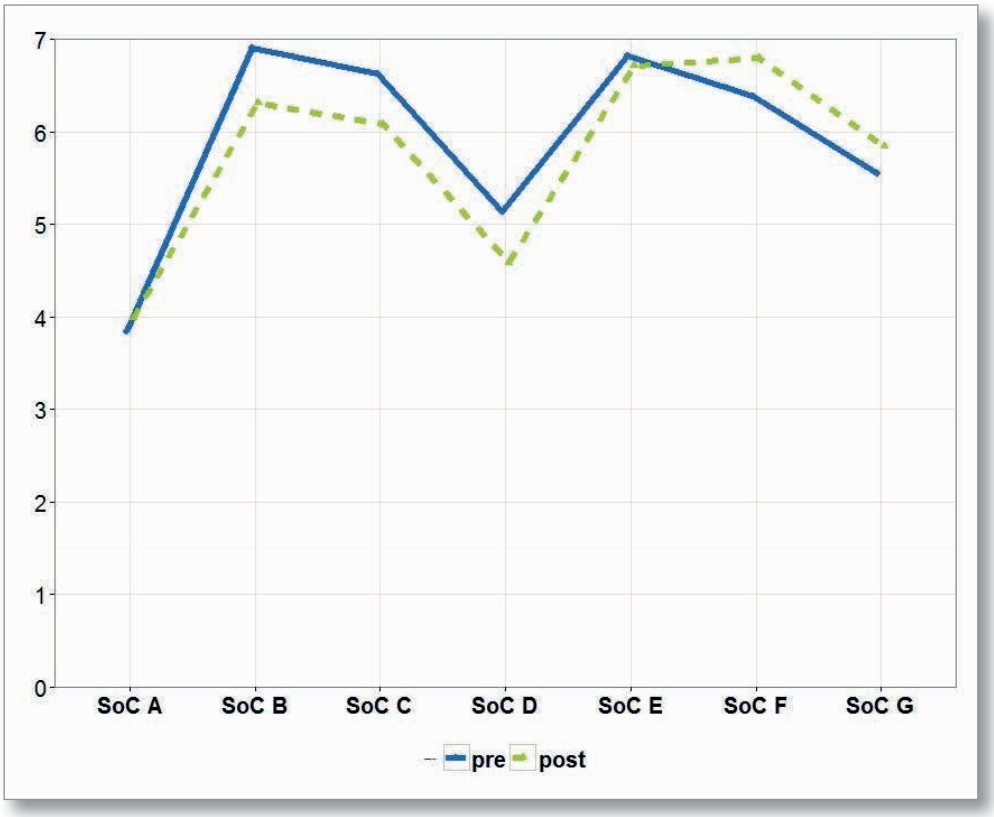

Figure 1. Stages of Concern profiles of the Georgian in-service teacher PROFILES group (N=19) in the pre- and post-tests; SoC A "Unconcerned"[1], SoC B "Informational", SoC C "Personal", SoC D "Management", SoC E "Consequence", SoC F "Collaboration" and SoC G "Refocusing" – Mean scores (Differences in SoC B and F are statistically significant – p < .05) (status: September 2013).

(SoC)" theory and questionnaire (Hall & Hord, 2011). The ISU team adapted a German SoC questionnaire, focusing on IBSE, which was developed and tested by Schneider and Bolte in accordance with Hall and Hord, (Schneider & Bolte, 2012). The Georgian questionnaire was applied as a pre- and post-test in the frame of the Georgian PROFILES continuous teacher-training programme for the both CPD rounds. Below the results of the analysis after the first round are presented. As the implementation process finished in June, 2014, the results of the second round are in progress.

19 science teachers from different regions of Georgia participated in the 1st PROFILES CPD programme (7 biology, 6 chemistry, and 6 physics teachers).

Regarding our more empirical insight, the analyzed Stages of Concern profiles for both times of collecting data (pre- and post-test) are shown in Figure 1.

We observe a 'positive' result regarding the development of the teachers' professional attitudes about the implementation of IBSE in school. At both times of collecting data, we monitored the typical SoC profile of a 'Cooperator' (Bitan-Friedlander, Dreyfus & Milgrom, 2004). With the theory of planned behaviour in mind (Ajzen, 1991), the participants of the PROFILES CPD programme in Georgia are expected to integrate IBSE related PROFILES modules into their teaching practice with high probability (Schneider, Kapanadze, Bolte & Slovinsky, 2013).

Analyses shows that the participating teacher are more informed about IBSE (SoC B) and have a stronger focus on Collaboration (SoC F) at the end of our PROFILES treatment course. Considering the SoC scale "Refocusing" (SoC G), the participants were also more concerned about optimizing IBSE at the end of the CPD course. These results can be considered positive for the implementation of innovative educational programmes (Hall & Hord, 2011).

[1] Please note: A high value on the SoC-Scale A "Unconcerned" means that the test persons' awareness about Integrated Science is on a low level.

Determining students gains (MoLE)

The goal of science education is to enhance students' scientific literacy. Students' motivation has been found to play the most important role in their conceptual change processes, critical thinking, learning and hence science learning achievement (Lee & Brophy 1996).

Instrument for analyzing Motivational Learning Environments (MoLE) in science classes (PROFILES, 2010) was translated into Georgian language. Data was collected in all PROFILES classes. About 2000 students were involved in this study.

As the PROFILES modules implementation period ended in June 2014, results are in progress and will be reported and shared among the consortium partners soon.

Curricular Delphi Study

The central aim of a Curricular Delphi Study, in the frame of PROFILES project, is to collect the opinions of stakeholders from different domains within society on the aspects of Science Education and classify them in a systematic and appropriate way (PROFILES, 2010) for guiding the professional development programmes for teachers within PROFILES.

The Curricular Delphi Study on Science Education in Georgia is structured into three rounds.

1st round

The PROFILES group in Georgia has used the same questionnaire as the FUB group in PROFILES (Bolte & Schulte, 2011). The questionnaire has been translated into Georgian language and adopted to the Georgian context, but has still remained as close as possible to the German version.

A final classification system for the analysis of the participants' statements was developed and established on the basis of the FUB system.

When comparing our results to the German

results, the main differences are apparent in some categories characterizing more pure scientific fields, such as optics or biochemistry/biophysics and also in some categories of concepts and topics, characterizing more new technologies and connection between phenomena. There are some differences visible also in qualification and methodological aspects. Georgian experts give, in more detail, the categories of inquiry skills in qualification and also stressed some methodological aspects on student-based learning.

Figure 2 shows the frequencies of the categories which were mentioned by the stakeholders. In the analyses, we have focused on categories that were mentioned rarely (<5%), or particularly often (>20%). The following descriptions were structured according to the different parts of the classification system, focusing on the results regarding the whole sample, as well as regarding the different sample groups. Here we present only the results for the whole sample.

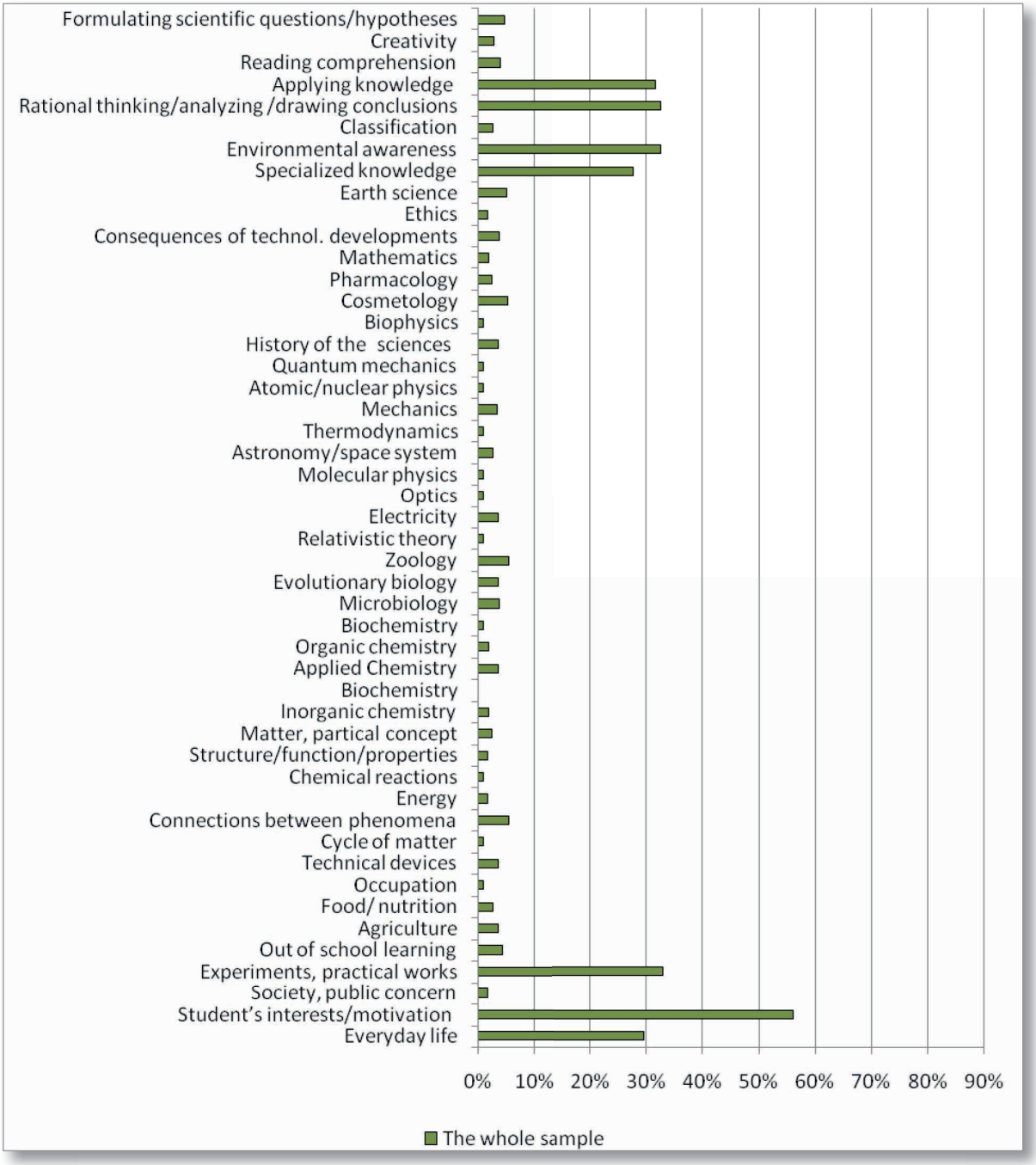

Figure 2. Overview of the categories that were mentioned rarely (<5%) or often (>20%): Mean percentages regarding the whole sample

2nd round

The second round of the Curricular Delphi Study was based on the questions which resulted from the first round analysis.

As the second round of Curricular Delphi Study consists of two parts, the results are presented in two parts also. The first part gives the descriptive and variance statistical analyses, the second part – hierarchical cluster analyses.

The results of the analysis of priority assessment shows that the top ten categories refer to the aspects related to general education and everyday life. The highest mean value, with the regard to priority in participants' responses, is the category "Acting reflectively and responsibly" and the lowest category, "Cosmetology." Most of the ten lowest categories refer to specific fields of science, such as Atomic/nuclear physics, Relativistic theory, or Pharmacology.

Analyzing these results, it is clear that, in some cases, different sample groups generally consider the same categories as relevant and important. The results of the analysis of practice assessment shows that the highest mean value is assessed as Mathematics by the total sample and the lowest mean value is the category, Occupation.

An analysis of priority-practice differences shows that the difference value is large in some cases. It is visible, that all the ten largest priority-practice differences feature values higher than 2.0, while the ten smallest priority-practice differences range between 1.1 and 0.79. These outcomes thus indicate that the priority values are larger than the practice values.

The maximal gap between priority-practice is given for the category, Inquiry–based science learning, and the smallest for inorganic chemistry. The difference for Curriculum framework is also low for Georgia, but still positive, not as is the case of FUB (Schulte & Bolte, 2012).

For identifying important concepts regarding science education, the participants were asked to combine, from the given set of 109 categories, those categories which seemed important to them in their own combinations. Based on the analyses of their responses, three concepts were formulated regarding desirable science education:

Concept A: Awareness of the sciences in social and scientific contexts, in both educational and out-of-school settings;

Concept B: Intellectual education in contexts of scientific inquiry, development of general skills and occupations;

Concept C: General science-related education and facilitation of student's interest in contexts of everyday life, using modern and various methods of education.

It is important to know that only a combination of these three concepts makes a pedagogically reasonable contribution to the desirable general and science related education.

3rd round

The aim of the 3rd round is to identify which priority and reality assessments the participants assign to the three concepts of desirable science education, derived from the hierarchical cluster analyses in the 2nd round. Also, to find out where, due to opinions of the participants, priority and realization in science education practice drift apart.

The results of the 3rd round are in progress to be announced soon.

Summary

The National PROFILES Conference was held at Ilia State University on 31st May, with about 100 participants. Teachers reported about their PROFILES practices at schools. The main conclusion made at the conference was: PROFILES offers varied teaching and learning approaches, promoting the development of diverse skills, including problem solving, team working, communication, organizational and investigative capabilities, all

with a specific focus on the development of Inquiry-based Education through Science Education in the classroom.

From the teachers' feedback, it is clear that the PROFILES modules were received very well and that the PROFILES project has been implemented successfully.

The results of the DELPHI Study, MoLE and SoC will help the educational professionals and teachers in Georgia to enhance the quality of science education.

PROFILES in Georgia is on a 'good course' to assist teachers, not only those participating in PROFILES, become better professionals and implementers of IBSE.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes, 50*(2), 179–211.

Bitan-Friedlander, N., Dreyfus, A., & Milgrom, Z. (2004). Types of "teachers in training": the reactions of primary school science teachers when confronted with the task of implementing an innovation. *Teaching and Teacher Education 20*(6), 607–619.

Bolte, C., & Schulte, T. (2011). PROFILES Curricular Delphi Study on Science Education. Interim Report on the First Round of the FUB Working Group. *Polyscript (Status July 2011). Unpublished*.

Bolte, C., Holbrook, J., & Rauch, F. (Eds.). (2012). *Inquiry-based Science Education in Europe: Reflections from the PROFILES Project.* Berlin: Freie Universität Berlin (Germany) / Klagenfurt: Alpen-Adria-Universität Klagenfurt (Austria).

Hall, G. E., & Hord, S. M. (2011). *Implementing change: Patterns, principles, and potholes (3rd ed.)*. Pearson Education.

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).

Kapanadze, M., Janashia, S., & Eilks, I. (2010). From science education in the soviet time, via national reform initiatives, towards an international network to support inquiry-based science education – The case of Georgia and the project SALiS. In I. Eilks & B. Ralle (Eds.), *Contemporary Science Education* (pp. 237–242). Aachen: Verlag Shaker.

Lee, O., & Brophy, J. (1996). Motivational patterns observed in sixth-grade science classrooms. *Journal of Research in Science Teaching, 33*(3), 585–610.

National Research Council. (2000). Inquiry and the National Science Education Standards. A *Guide for Teaching and Learning* (8th ed.). Washington DC: National Academy Press.

PROFILES. (2010). www.profiles-project.eu

Rocard, M., Csermely, P., Jorde, D., Lenzen, D., Walberg-Henriksson, H., & Hemmo, V. (2007). *Science Education Now: a renewed pedagogy for the future of Europe*. Brussels: European Commission.

Schneider, V., & Bolte, C. (2012). Professional Development regarding Stages of Concern towards Inquiry based Science Education. In C. Bolte, J. Holbrook, & F. Rauch (Eds.), *Inquiry-based Science Education Europe: Reflections from the PROFILES Project* (pp. 71–74). Berlin: Freie Universität Berlin (Germany) / Klagenfurt: Alpen-Adria-Universität Klagenfurt (Austria).

Schneider, V., Kapanadze. M., Bolte, C., & Slovinsky, E. (2013). Project PROFILES and Development of In-service Teachers' "Stages of Concerns" Regarding IBSE in the Context of the Implementation of PROFILES Modules in Georgia. *Proceedings of the International Conference on Physics Education, ICPE-EPEC*, pp. 1039–1043. Prague: Czech Republic.

Schreiner, C., & Sjøberg, S. (2004). ROSE: The relevance of science education. Sowing the seeds of ROSE. *Acta didactica*, 4.

Schulte, T., & Bolte, C. (2012). European Stakeholders Views on Inquiry Based Science Education – Method of and Results from the International PROFILES Curricular Delphi Study on Science Education Round. In C. Bolte, J. Holbrook & F. Rauch (Eds.), *Inquiry-based Science Education in Europe – Reflections from the PROFILES Project* (pp. 42–51). Berlin: Freie Universität Berlin

(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

Marika Kapanadze & Ekaterine Slovinsky – Ilia State University, Georgia

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