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COMMUNICATION

The Importance of School and Company Cooperation in Promoting Science Education in Georgia

Natela Bagatrishvili
Telavi Public School N7, Georgia
Iakob Gogebashvili Telavi State University, Georgia
natia.baghatrishvili@tesau.edu.ge

The article examines the cycles and results of an action research carried out as part of the ARTiST project implemented in Georgia with the participation of students from Telavi Public School N7. The activities of the teacher in the context of the action research and the study results are highlighted; the positive changes in terms of the development of practical skills of the students in the project-based activities are dealt with. In particular, the article describes how school science projects carried out in collaboration with a company change the meaning of the perspective of applying knowledge and experiences that students have gained in school in everyday life.

Keywords: Action Research; School and Company Cooperation; Practical Skills

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Introduction

As part of ongoing educational reforms, action research has been initiated in Georgia. Under the provisions of 2015-2019 (Guidebook of Teacher Professional Development Scheme in Georgia, 2016), it became an integral part of teacher professional development. This novelty was a challenge for most teachers, and sceptical opinions were often voiced on their part.

As a result, various competent organizations offered training courses for teachers to give them instructions on how to carry out action research and to help them improve their knowledge, experience, and qualifications. A lecture course in action research was also included in most university curricula for educating current and future teachers.

Action research comprises several stages and is at the same time cyclical in nature (Mamlok-Naaman & Eilks, 2012). It requires the proper selection of research tools, monitoring, and conducting interim and final evaluations. It is therefore important that the training is developed as a long-term program and not as a one-off informational meeting (Eilks, 2018).

Among them, the Science Research Center SALiS (SALiS, 2012) at Ilia State University in Georgia provided significant support to science teachers in the framework of the EU's ERASMUS+ project *Action Research to Innovate Science Teaching* (ARTIST, 2016). The main goal of the ARTiST project was to promote and support science education through reflection on teacher action research: "*Facilitating science teaching through teacher action research*" (The ARTIST Guidebook; Eilks et al., 2019, p. 3). Action research is aimed at cyclical improvement of teacher action through the further development of research, reflection, and innovative approaches.

The introduction of certain changes and the interest in new products in the context of action research make it possible to discover new knowledge, experience, and strategies for better practices, which not only serve to introduce innovative ideas but also contribute to the continuous professional development of current teachers.

To increase student interest and motivation, as well as improve learning outcomes through activities carried out during action research, ARTiST has developed a unique approach that creates a network of collaboration between universities, schools, and industry (small and medium-sized companies). Each higher education institution involved in the project creates a regional network of universities, secondary schools, and industry representatives (small and medium-sized enterprises)" (The ARTIST Guidebook; Eilks et al., 2019, p. 4).

Objectives, Methodology, and Cycles of the Research Carried Out

Telavi Public School N7 was also involved in the ARTiST project along with other public and private schools in Georgia. Cheese production was selected as the working topic and *Tsivis Kveli* was selected as a partner company. The implemented project module was called "From School Laboratory to Cheese Company". The research question, which was in line with the objectives set in the National Curriculum that the school should contribute to the development of various transparent competencies (National Curriculum 2018-2024, 2016), was as follows: To what extent do project activities help students develop their practical skills?

Following the concept of ARTiST, the main tasks of the project module "From School Lab to Cheese Company" were as follows:

- Build close collaboration between schools, universities, and companies and bridge the gap
- Encourage students to develop practical and collaborative skills in science classes
- Increase students' interest and motivation for science by involving them in cheese-making activities
- Transfer the knowledge about cheese making, learned in science classes, into practice

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To achieve the goal, two cycles were implemented based on the concept of the ARTiST -project. As described in the ARTiST-Guidebook (Eilks et al., 2019), each of them comprises four stages (**Figure 1**).

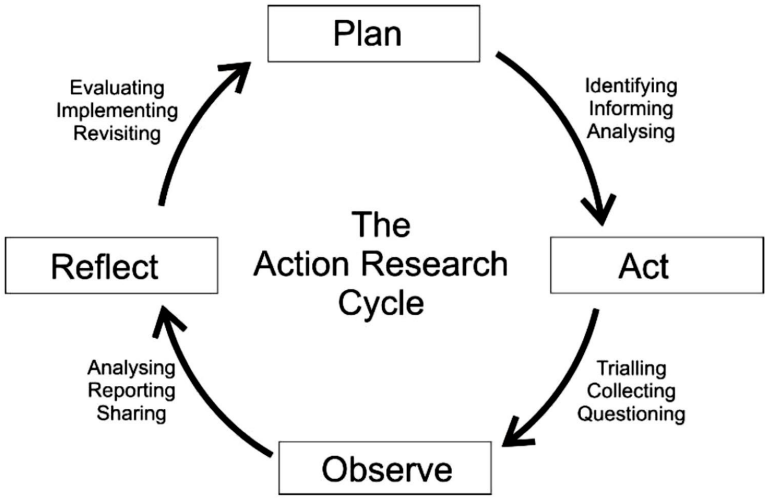

Figure 1. *Model of the action research cycle (Eilks et al., 2019)*

In the first cycle, the students visited the company and familiarized themselves with the content of the project. It was important for me to explain to the students that this was not a simple excursion but an educational visit. It turned out that it was difficult for both students and company employees to understand the fact that the theoretical materials taught in science classes were closely related to cheese-making. So, I found it important to examine the real situation thoroughly. Specifically, we asked students and employees of the company if they believed that the knowledge and skills gained in science lessons were important for everyday life and work in various professional fields.

The research was conducted using the following methodology:

- In-depth interviews of semi-structured nature with the company head individually, and focused interviews with the employees
- SWOT analysis of existing reality

The students were provided feedback by a:

- Quantitative method using the questionnaire on motivation (Bolte, 1995)
- Qualitative method through focused, semi-structured interview

Based on the content of the prepared interview transcripts, I coded the concepts so that I could categorize them. Emphasis was placed on four concepts: the relationship between science disciplines and careers, the importance of the school-business relationship, different practical skills, approaches to learning, and the growing interest of students.

Analysis of the transcripts revealed poor student awareness of the use of science in life. Students couldn't combine science with a career. In their view, science education was only associated with medical training or the acquisition of a particular science - chemistry, physics, or biology. Hence, it is logical to think that the teacher's approach to the student is very important in recognizing these relationships. Additionally, in the survey, students mentioned that they like hands-on lessons because they are interactive, varied, and tailored to their interests.

The same results were shown in the surveys of the head and employees of the company. They had no prospect of applying the knowledge they gained from studying science at school. "*I couldn't have imagined researching milk proteins and fats or the detection of pathogenic microorganisms in them, although my parents had this business even when I was studying these subjects in school. In fact, I have rediscovered the structure of organic compounds and the properties of bacteria*"- said the head of the company. Therefore, he believes that students need to be connected through projects with different companies from an early age to put the theoretical knowledge of science into practice. When asked what kind of science lessons are better, the company director clearly stated: "*There should be an agreement between schools and companies so that students can have more practical lessons in order to get used to combining mental and physical work at an early stage, depending on their age.*"

As for company employees' surveys, they think that the following skills and qualities are required to work in the company: due diligence, expediency, responsibility, practicality, compliance with safety rules and submission, as well as concern for one's own development.

Based on the results of the study and the existing reality, the needs of the students were highlighted and effective activities were planned to increase the students' awareness and understanding of the importance of science education and its use in everyday life, which is also the case would help them choose a career and enable them to develop their research and practical skills.

A project was also created with the following activities:

- Materials on the making process of cheese were collected
- The students created a company model
- In the school laboratory, optimal conditions for cheese production were determined
- Three visits were made to the "Tsivis Kveli" company, where students took part in the cheese-making process
- The students made cheese labels
- Presentation of events was held, in which school children and company representatives took part

The second cycle was carried out after the implementation of the activities planned in the first cycle. In parallel with each lesson, the teacher made constant observations. In particular, a research diary was created in which the teacher kept writing down the observation results. An assessment rubric was also developed to determine the level of students' ability to plan and conduct research. In addition, a rubric was created to assess students' practical skills development. Having studied the assessment rubrics, we were able to carry out an interim assessment and consolidate the results of a quantitative study with students.

After completing the second cycle, the second phase of student study was carried out:

- Quantitative study using a questionnaire on motivation (Bolte, 1995)
- Qualitative study using focused interviews

Findings and discussion

In a post-interview, the students viewed working in wine production, milk processing, pharmacological and inorganic and organic fertilizer production, and in research laboratories of various kinds as areas of employment in which science plays an important role.

There have been significant changes in their thinking in this regard. We had completely different results compared to the previous interviews. This time the students were able to easily combine their school knowledge with practical activities and realized the importance of the new material introduced to them during the module introduction, especially the role of enzymes in cheese making.

The students discussed and compared the rules of conduct in the school laboratory with those of the company. The students found that working for the company helped them develop practical skills and habits to maintain standards of behavior and safety in the company.

They also noted, "*We have developed our team, presentation and communication skills throughout the project. The most important thing was that we were learning and having fun at the same time. Each of us in the company had a role; we have adapted our roles well.*" As a result, they expressed their willingness and desire to participate in other similar projects, for example, to familiarize themselves with winemaking and meat production technologies and to carry out work-related hands-on activities.

Above all, students' motivation and interest in science increased. One of the students said: *"I thought the project would not be that interesting, but it definitely was."* Moreover, students now believed that participating in such projects would help them choose their future careers, they stated: "*In the course of the project, we got acquainted with the needs, requirements, and problematic areas of various professions. As a result, it's now easy for us to choose a future career; we not only got to know the production conditions but also advertising and sales. Our expectations were met and we did even a little more than we thought.*"

A comparative analysis of the quantitative survey instruments - pre- and post-questionnaire results - showed significant positive changes. As shown in **Figure 2**, at the beginning of the project implementation, the majority of the students felt that the project initiated by the teacher was of little importance to them personally and also to the community. After the completion of the project, they emphasized that participating in the project was an important experience for them.

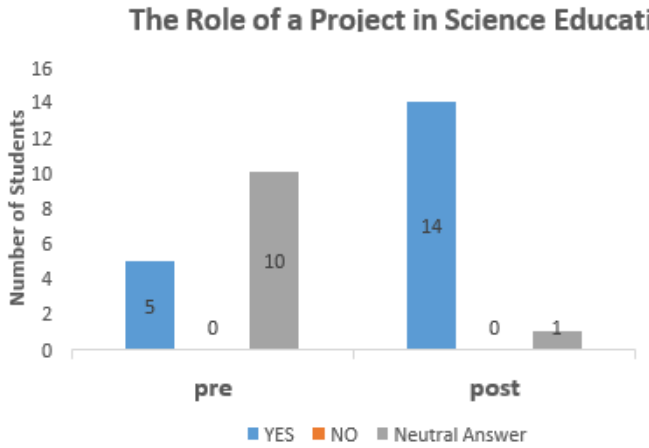

Figure 2. *The role of the project in science education*

In the early stages of the project, most students felt that the participation and interest of their classmates would be very low, and they would not willingly follow the teacher's instructions. However, at the end of the project, the students found that they worked with great interest and wanted their teacher to resume and implement similar projects again in the future. Looking at the pre- and post-questionnaire results, it was found that the students felt positive as the project progressed, as the activities they carried out were enjoyable and interesting for them. The satisfaction they received during the project exceeded their expectations (**Figures 3 and 4**).

Figures 3 and 4 show a correlation, which confirms that students are satisfied with their participation in the project and, as a result, satisfaction increases their motivation and desire to continue participating in other similar projects. The results of the study also show that the students were not restricted in their actions. They asked questions and expressed their opinions, which the teacher always considered.

Based on the research findings, at the beginning of the project, students found it difficult to identify the relationship between practical activities and science subjects. When the students first were introduced to the project, they thought they could just learn the basic principles and rules

of conduct for working in the company, but they found it unrealistic to master production skills. That is, they did not believe in the possibility of putting theoretical knowledge into practice and developing practical skills. At the end of the project, all students stated that they had the skills to work for the company, especially in a cheese factory (**Figure 4**).

Students' opinions can be supported by their research diary entries and rubrics created to evaluate their work, as a result of the analysis the following can be stated:

- Students developed certain research skills, they work according to written instructions, but have difficulty in planning their studies on their own.
- Students easily navigated between different parts of the company. In the process of work, they observed the rules of conduct and safety precautions, as well as the instructions of the personnel, and used special equipment to independently produce cheese of various types, shapes, and sizes.
- Students interacted with each other, asked questions to adults when necessary, and used ICT.

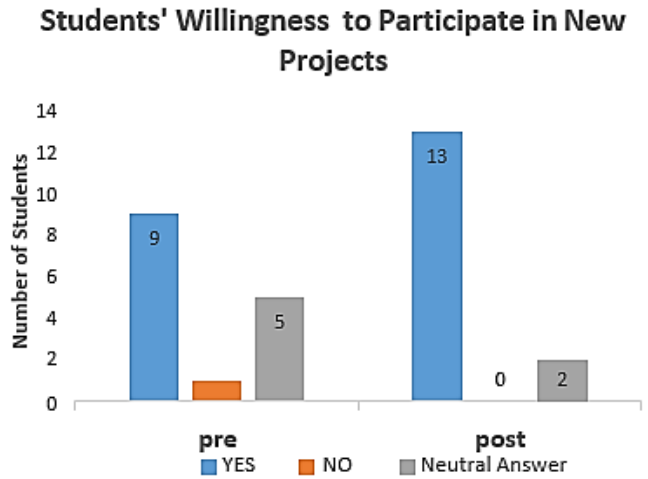

Figure 3. *Students' willingness to participate in new projects*

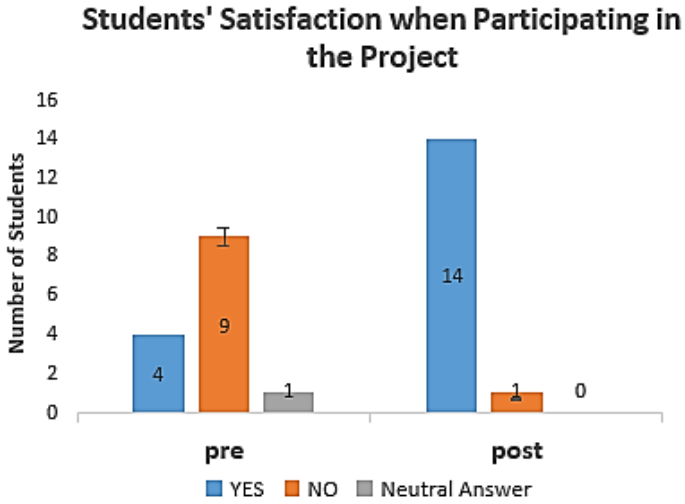

Figure 4. *Students' satisfaction when participating in the project*

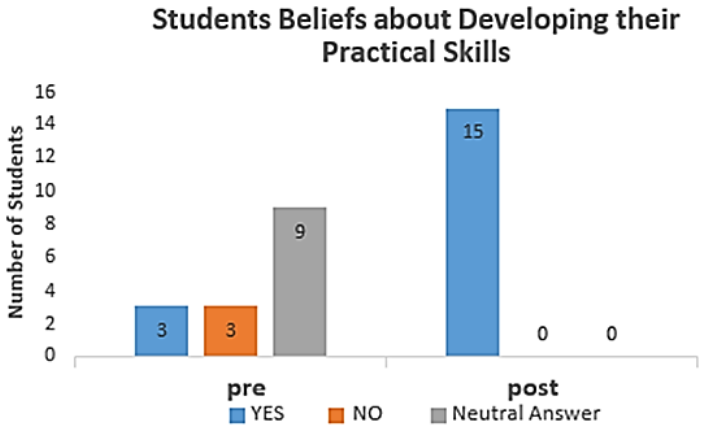

Figure 5. *Students' beliefs on developing their practical skills after participation in the project*

Conclusion

Looking back on the research question, it can be said that the project and the activities it contained made a significant contribution to the development of the students' practical skills. It is important to implement such jointly coordinated projects through participating schools, universities, and companies to increase the independence, interest, and motivation of the students as well as the development of their practical skills. In addition, such projects also play an important role in the choice of future careers for students, allowing them to combine the knowledge and experience acquired in school with everyday situations and apply them in the context of life.

Finally, it can be said that action research is also important for the professional development of teachers, which is directly impacting the improvement of students' skills and knowledge. Because of the nature, importance, and usefulness of such research, it is important that teachers of all statuses, ages, and work experience continually monitor, analyze, and evaluate the teaching approaches they use in a particular classroom or with a group of students to ensure that their lessons are engaging and full of innovations. As can be seen, the cooperation between the school and the company plays a decisive role in this, as it allows students to put their academic knowledge into practice.

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