International Journal of Computational and Experimental Science and ENgineering (IJCESEN)
Vol. 8-No.2 (2022) pp. 56-58
http://dergipark.org.tr/en/pub/ijcesen

ISSN: 2149-9144

Research Article

A Teaching Method for the Natural Sciences

Naim SYLA[1], Jürgen SCHONHERR[2†] Edina MALKIC[3] and Fisnik ALIAJ[4*]

[1]University of Prishtina, Department of Physics, Pristina –KOSOVO
Email : naim.syla@uni-pr.edu **ORCID:** 0000-0003-0857-4685

[2]GERMANY (died from COVID19 in December 2020)
Email : nsyla1964@gmail.com **ORCID:** 0000-0003-0857-4685

[3]MU "Interaktivne otvorene skole" Ul. Pozorišna 13,75 000 Tuzla, B&H,
Email: muios@bih.net.ba **ORCID:** 0000-0003-0857-4685

[4] University of Prishtina, Department of Physics, Pristina –KOSOVO
* **Corresponding Author Email** : fisnik.aliaj@uni-pr.edu **ORCID:** 0000-0002-9967-8334

Article Info:

DOI: 10.22399/ijcesen.1034925
Received: 17 December 2021
Accepted: 09 June 2022

Keywords
Experiment,
Starter Approach,
Natural Sciences,
Mathematics

Abstract:

In this contribution, we will introduce a new method of teaching and learning for the natural sciences (Biology, Physics, Chemistry) and Mathematics. The inventor and practical implementer in several world countries (Indonesia, Tanzania, Kosovo, Kyrgyzstan, Kazakhstan, Bosnia & Herzegovina, and some schools in Germany) was Jürgen Schőnherr. The philosophy of this method is based on the idea that the first lesson of each chapter begins with an experiment, which should be clear, simple (built with ordinary tools from students' lives, kitchens, toys, tools, etc.), and have a surprising effect. Based on this approach, the method is also called Starter Experiment Approach. The role of the teacher during this lesson will be more of a guide and helper, while most of the time will belong to the students. Thus, students will be aroused with curiosity and love for natural sciences. In countries where this method has been applied, positive effects have been observed in increasing the number of researchers in the natural sciences, and their success.

1. Introduction

Most research in natural sciences and technology depends on the design and implementation of the research experiment [1-5]. Given the importance of experimentation in the natural sciences and technology, different teaching methods and mathematics methods have recently been developed. These methods are applied from primary school, when students firstly have contact with subjects such as physics, chemistry, biology and mathematics [6-11]. One of the most important methods, which has shown practical results [7,8], is undoubtedly the one we will present in the following.

The name "Starter Experiment" was chosen to indicate two things [7]:
The process of teaching/learning in science has to **start** from the observation of phenomena, either obtained from the environment or an experiment (Martin Wagenschein).

Starting a new chapter of the syllabus or in the textbook shall be based on students' observations of natural phenomena, or derived from a "Starter-Experiment". For their explanations, they are using their pre-concepts / pre-knowledge, which will be confronted with the science concepts in the course of the 'SEA-lesson'. These concepts will be developed by students as a result of their investigations to test their hypotheses for correctness. Thus, new concepts are developed as a result of the teaching/learning process, correspondingly, the new concepts are replacing incorrect pre-concepts (Jean Piaget: Restructuring). This way, students will avoid developing two unconnected sets of knowledge; one they use for getting along in their environment, in their daily life, in the family and community, and the other one to cope with the demands in school. For this purpose, each chapter of the syllabus should be started, if possible, by this approach.

"Re-uniting" students' worlds -their environment and the school- makes learning meaningful and motivating for them. Both being the precondition of the improvement of the teaching / learning process esp. in science subjects.

2. The Steps of the Approach

The Starter Experiment Approach follows the "Scientific Cycle" * [7,8]:

1. Observing phenomena either directly in the environment or through an experiment;
2. Attempting to Explain why certain things were observed, students using their pre-concepts;
3. Verifying/Falsifying the attempted explanations (hypotheses) by means of experiments, preferably designed by the students themselves;
4. Assessing the attempted explanations by means of the results of the verification experiments;
5. a) Formulating a Concept in case of a positive assessment of the hypothesis. Or b) Formulating a New Hypothesis in case of a negative assessment of the original hypothesis followed by a new verification process;
6. Linking the Concept to students' environment and its applications in technology and science;
7. Evaluating students' degree of comprehension of the newly found concept.

***) T**here is a slightly different procedure for mathematics.

3. Teaching with the Starter Experiment Approach

To teach science while using this approach successfully, the teacher needs to undergo a training covering both, methodology and contents. Since this approach is very different from what teachers are used to doing, the training must also provide them with a considerable self-confidence in their ability to apply the new strategy. After having undergone the training -the training itself is described under the chapter "Training Structure"- the teachers are expected to conduct science lessons following this very approach at least each time when they ***start*** with a new chapter of the syllabus. Thus, students will develop a high degree of motivation, which will last for the periods to follow, even if the teacher falls back to more traditional ways of instruction. However, it is important that frequent references are made to the initial Starter Experiment for this chapter. This way the motivation can be sustained for a long time.

4. Effects of SEA on Students and Teachers

Teachers applying this method will experience a change in students' attitude towards science subjects and mathematics: Students will start investigating questions outside the actual science lesson, e.g., by designing and conducting their own experiments at home. Students will bring "improvised equipment" to the school to demonstrate certain experiments they have "invented". Students will utter their satisfaction with the subject, and will include their science and/or mathematics teacher in such statements. In turn, teachers will observe some changes in their own attitude towards the lessons they have to give. They will observe that they spend more time thinking about these lessons, they will spend more time preparing them, they will become more open to students' questions and suggestions, and they will find teaching satisfactory and rewarding...

Some other effects frequently observed [7,8]:

- Students become more tolerant towards deviating ideas of classmates.
- Students become more supportive among each other.
- Girls are more respected and are actively involved in lessons traditionally regarded as the domains of boys.
- The positive attitude towards science subjects and mathematics ***spills over*** to other subjects.
- Due to the training element ***Mutual Monitoring*** the cooperation of teachers increases.

5. The Training Structure

At the first step of the training, participants are exposed to a lesson following the steps of the Starter-Experiment-Approach. They experience the desired teaching/learning process in the role of students, the trainer being the "model-teacher".
This is followed by analyzing the approach step by step, and backing them up by short lectures about learning psychology, the way knowledge is created. Here participants find themselves in the role of college students. Based on the experience gained in the previous steps, participants are asked to select a topic from the curriculum and to prepare a lesson following the new approach, still in the role of college students.
In the role of teacher, each participant is given the chance to tryout the lesson they have planned in a "Peer-Teaching" session, whereby the other participants are acting as students. During the peer-teaching performances the trainer acts as a

monitor, modelling the way effective monitoring can be done. In the course of the peer-teaching exercises, the trainer involves the participants successively in monitoring the demonstrating colleague. They now take part in two roles: The role of student and the role of monitor. To reduce the fear to fail when applying the new approach back in their schools all participants will teach "their lesson" in a normal class with normal students. One participant is the teacher, the remaining participants act as monitors. Thus, self-confidence increases, the fear to fail vanishes. Back in their schools' participants have to apply the new approach for at least six times within the following 6 to 9 months. These "SEA-lessons" must be monitored by one colleague who has also undergone the SEA-training. After 6 to 9 months' participants attend a refresher seminar. Here participants discuss their experience gained by applying SEA in their schools, focusing on problems/difficulties observed, and developing adaptations to overcome them, meanwhile, the trainer acting mainly as organizer and source of ideas.

6. Conclusions

- The SEA method is suitable and effective for the natural and mathematical sciences.
- Starts to apply from primary school and especially from the fifth grade
- It is easily feasible because it does not require special laboratory equipment (tools are taken from the daily life of students).
- The results prove that, by applying this method, the students' interest in natural sciences increases, and what is more important, the prejudices that natural and mathematical sciences are difficult fall [7].

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
- **Acknowledgement:** Authors want to thank Jürgen Schönherr - Papa SEA (already deceased), Am Grundweg 82, D-64342 Seeheim-Jugenheim, Germany, who was the inventor of this method. From all the materials that Jürgen had prepared for the various trainings, the authors are summarized in this article.
- **Author contributions:** The authors declare that they have equal right on this paper.
- **Funding information:** The authors declare that there is no funding to be acknowledged.
- **Data availability statement:** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

References

[1] A. Kaouka et al. (2020), Characterization and Properties of Boriding Titanium Alloy Ti6Al4V. *Acta Physica Polonica A*137(4):493-495 DOI: 10.12693/APhysPolA.137.493

[2] I. Bozetine eta al. (2020), Study of the Influence of the Annealing Temperature on the Properties of SiC-SiO2 Thin Films, *Acta Physica Polonica* A137(4):499-501 DOI: 10.12693/APhysPolA.137.499

[3] İ.H. Kara eta al. (2020), Effect of Ca and Ce on Wear Behavior of Hot-Rolled AZ31 Mg Alloys, *Acta Physica Polonica* A137(4):557-560 DOI: 10.12693/APhysPolA.137.557

[4] H. Ahmad Mukifza eta al. (2017), Experimental Analysis of Titanium Dioxide Synthesis from Synthetic Rutile Waste using a Moderate Acid Concentration and Temperature, *Acta Physica Polonica* A132(3II):833-835 DOI: 10.12693/APhysPolA.132.833

[5] N. Syla et al, (2017) Hardness Curves for 31CrMoV9 Steel after Gas Nitriding. *Acta Physica Polonica* A132(3):484-486 DOI: 10.12693/APhysPolA.132.484

[6] Brekke, M., Hogstad, P.H. (2010), New teaching methods - using computer technology in physics, mathematics and computer science. *Int. J. Digital Soc.*, 1

[7] Naim Syla, Gezim Hodolli (2017), The teachıng method named "Starter-experıment-approach", Chemistry: *Bulgarian Journal of Science Education*, 26:6.

[8] Indrayati, N.K., Renda, N.T. & Sudarma, I.K. (2014). Pengaruh model pembelajaran starter eksperiment approach terhadap keterampilan proses sains. *e-J. MIMBAR PGSD Universitas Pendidikan Ganesha Jurusan PGSD,* 2(1).

[9] Kitta, S. (2015). Development of mathematics teachers: experience from Tanzania. *Int. J. Educ. Sci.*,

[10] Mistler-Jackson, M. & Songer, N.B. (2000). Student motivation and internet technology: are students empowered to learn science. *J. Res. Sci. Teaching,* 37:459 – 479.

[11] Niess, M.L. (2005). Preparing teachers to teach science and mathematics with technology: developing a technology pedagogical content knowledge. *Teaching & Teacher Edu*c., 21:509 – 523.