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Inquiry Based Science Learning in Primary Education

Ana-Maria Suduc[a]*, Mihai Bizoi[a] , Gabriel Gorghiu[b]

[a]*Faculty of Electrical Engineering, Electronics and Information Technology, Valahia University Targoviste, 13 Aleea Sinaia str., Targoviste, 130004, Romania*

[b]*Teacher Training Department, Valahia University Targoviste, 5 Moldovei str., 130093 Targoviste, Romania*

Abstract

Inquiry based science education (IBSE) proved to be stimulating for students' motivation, pupils' application of research skills, construction of meaning and acquiring scientific knowledge. Since inquiry is the preferred instructional method for elementary science classes, primary and pre-school teachers were invited to adapt and implement in classroom, science modules based on inquiry approach which were designed and developed by Romanian science teachers in the frame of the PROFILES FP7 project. The paper presents the feedback collected from students in order to evaluate, mainly, the success of those modules on increasing students' interest and motivation in science classes.

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Keywords: Inquiry Based Science Education, primary education, student's feedback, science lesson attractiveness, student's motivation

1. Introduction

Young students tend to be more curious and motivated to learn (Spencer & Walker, 2011). Therefore the teachers' effort to increase the students' interest in science education should begin at early ages.

Inquiry based science education (IBSE) proved to be stimulating for students' motivation, pupils' application of research skills, construction of meaning and acquiring scientific knowledge (Alake-Tuenter, et al., 2012) (Suduc, Bizoi, & Gorghiu, 2014). Inquiry-based strategies incorporate questioning and active engagement for student learning. Inquiry uses skills that are active, persistent, and based on a person's knowledge. It involves exploration, questioning, making discoveries, and testing discoveries to search for new understanding (Lemlech, 2009).

* Ana Maria Suduc. Tel.: +40-722548868
E-mail address: suduc@ssai.valahia.ro

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According to (Spencer & Walker, 2011) (Bybee, et al., 2006), inquiry is the basic building block for science education for elementary schools and helps students evaluate their responses and allows them to clearly communicate and support their answers with evidence.

In the following section there are presented the findings of a study which aimed to empirical evaluate if educational activities which implement inquiry based strategies are more successful than the actual science lessons and also if these IBSE activities are more close to the students science class ideal than the actual ones.

2. Method and results

2.1. Background

In the frame of the FP7 Project entitled: "*PROFILES - Professional Reflection Oriented Focus on Inquiry-based Learning and Education through Science*", in Romania, it was developed and organized an in-service teacher training program for science teachers, called: "*PROFILES - Education through Science*". At the end of the training program, each teacher developed an educational module that integrates inquiry-based strategies. The modules were published in the Romanian PROFILES website (http://www.profiles.ssai.valahia.ro). Science teachers, primary and even preschool teachers were invited to use those IBSE modules in their classroom activities.

Although primary and pre-school teachers are not part of the PROFILES project target group, since inquiry is the preferred instructional method for elementary science classes (Allen, 2006), primary and even preschool teachers were invited by the PROFILES Romanian team to use those modules in their classroom activities, after their adaptations imposed by the students' age and knowledge background.

To this invitation, in spring 2014, 6 pre-school teachers and 12 primary education teachers have responded. The teachers have selected as basis PROFILES modules, which are focused on problems appropriate to children age, proposed by the science teachers for secondary education science classes, and adapted the activities according to the target group profile (Suduc, Bizoi, & Gorghiu, 2014). In the implementation process, there have been involved 18 teachers (6 pre-school and 12 primary education teachers) and 244 children (50 pre-school and 194 primary students) at all class levels, except the small group at preschool level.

2.2. Method

In order to evaluate the success of the IBSE activities, feedback questionnaires have been used and applied both to teachers and students.

Since the pre-school students, preparatory and a part of the first grade students didn't have enough reading and writing knowledge, so that their teachers tried to express a collective students' feedback. Do to the inherent subjectivism of the teachers who expressed the collective students' feedback, in this paper there have been presented only the findings and results obtained by the analysis of the feedback questionnaires filled in by the students themselves. Therefore, 136 primary students (Fig. 1) from 8 classes, 2 at each grade level (1st to 4th grade), filled in three feedback questionnaires.

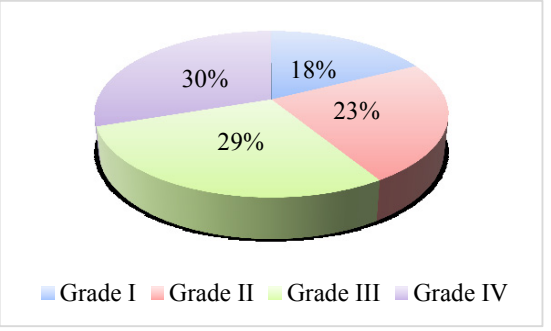

Fig. 1. Distribution of students per grade.

In terms of PROFILES modules selected as basis for the IBSE activities implementation, taking into consideration the students' age, it is not surprising that the teachers have chosen modules about water and food. The module entitled "Are we what we eat? The daily menu choice" was implemented by a class at each grade level. "Let's eat healthy!" was implemented at 1st and 2nd grade and "Water and life" at 3rd and 4th grade.

The students' feedback was collected using three questionnaires (Bolte, 2006):

- questionnaire A was applied before the IBSE module class implementation and meant to find out the students perspective on actual science classes;
- questionnaire B was applied also before the implementation and collected the students perspective on an ideal science class to which they would like to attend;
- questionnaire A was applied again, after the IBSE module class implementation, being focused on students opinions about the activities which included IBSE strategies.

Both *Questionnaires, A* and *B*, contain questions/statements about Science lessons related to: attractiveness (Q1.), satisfaction (Q2.), topic understating (Q3.), time for thinking (Q4.), content - about signs and symbols (Q5.), content - about studying facts and figures (Q6.), importance to everyday life (Q7.), importance to society in general (Q8.), opportunity to make suggestions (Q9.), opportunity to ask questions (Q10.), level of class co-operation (Q11.), level of class effort (Q12.), level of individual effort (Q13.) and participation degree (Q14.)

2.3. Findings and results

The aim of collecting the students' feedback was to determine if activities which implement IBSE strategies are more successful than the actual science lessons and also if these IBSE activities are more close to the students science class ideal than the actual ones.

Comparing the students' feedback about actual science lessons and IBSE lessons, it was find out that, on the average, 45% of the students considered that from different aspects the two type of lessons are the same. For example, 51% of students gave the same answer before (about actual science lessons) and after (about IBSE science lessons) the implementation to the question related to topic understanding. Thus, for 51% the IBSE activities didn't change anything in terms of topic understanding. Other 50% of students considered they have the same *opportunity to ask questions* in both lessons - actual and IBSE. The same percentage, 50% of students gave identical answers to the questions about *level of individual effort* and *content - about studying facts and figures*. At the other extreme, only 32% of students considered that two types of lessons are identical in terms of *importance to society in general*.

For 86% of the students it is *important* (27%), *very important* (24%) or *extremely important* (35%) to participate to *enjoyable* science lessons. The results show that for 95% of students, the IBSE activities were at least *enjoyable*, compared to 83% who find actual science lessons *enjoyable* to *extremely enjoyable* (Fig. 2). Thus, although the actual science lessons are not far from ideal, in terms of enjoyability, the IBSE activities exceed the ideal.

In (Dumitrescu, Olteanu, Gorghiu, & Gorghiu, 2014) it is presented the feedback of 189 students at lower and upper secondary school level who participated to Chemistry lessons which implemented IBSE strategies. If for 86% of the primary students it is *important*, *very* or *extremely important* to participate to *enjoyable* science lessons, for the secondary school students the expectations for Chemistry lessons are higher: for 91% of the students is, at least, important to participate to enjoyable lessons. Those expectations are met in actual lessons for 69% of the secondary school students and for 83% of the primary students. IBSE activities met the expectation in terms of enjoyability for 80% of the secondary school students and for 95% of the primary students.

For 58% of the participant primary students it is *extremely important* or *very important* to feel contented in their science lessons. 69% of the students felt *very* or *extremely contented* in the science lessons which implemented IBSE activities compared to only 47% which feel the same in their actual science lessons.

Comparing once again with the results from (Dumitrescu, Olteanu, Gorghiu, & Gorghiu, 2014) we find out that it is *very* or *extremely important* to feel contented in their Chemistry lessons for only 49.7% of the secondary school level students, compared to 58% of the primary students who feel the same for the science lessons. A very low percentage of secondary school level students, 29,1%, feel *very* or *extremely contented* in their Chemistry lessons, compared to 47% of the primary students in Science lessons. The IBSE activities gave a similar level of contentment for 30,8% of the secondary school students and for 69% of the primary students. It can be noticed that the results of

this comparison, primary vs. secondary school levels, is one more proof of decreasing, in time, of students' interest in studying Sciences.

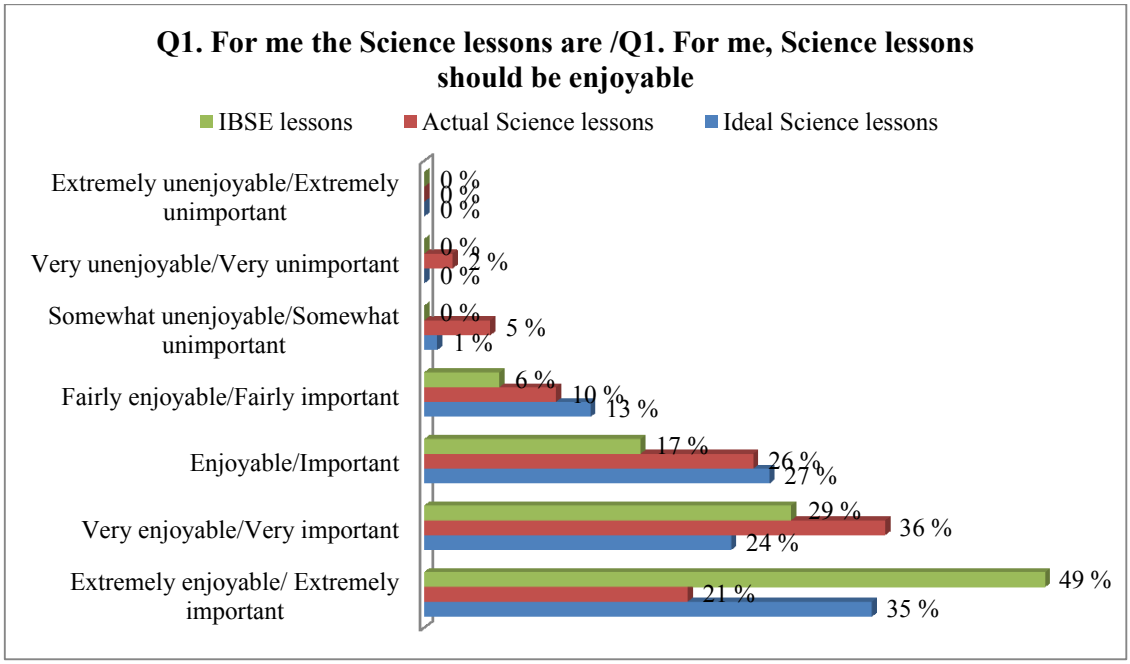

Fig. 2. The level of enjoyability of science lessons. Comparison: IBSE science lessons - Actual science lessons - Ideal Science lessons.

79% of the participating primary students understand always, very often or often the subject matter during the actual science lessons. In science lessons which implemented IBSE activities this percentage raised to 92% of the students. This result may conduct to the conclusion that letting and guiding the students to find the answers / solution to questions / problems by themselves may lead to a higher level of students understanding.

In terms of *time to think about the question asked*, in IBSE activities with 10% more students had *always* or *very often* time to think than in actual science lessons.

An interesting result was obtained to the question related to the level of importance to their everyday life of the topics (Fig. 3). Although for 37% of the students it is extremely important the science lessons to be useful in their everyday life, neither the actual (17%) nor the IBSE activities (19%) are close to the ideal. If we consider the last upper three levels of importance, *important, very important* and *extremely important*, the results are similar to ones from the previous questions: the IBSE activities (90%) are above the ideal (88%) and the actual science lessons (78%) are below.

For only 45% it is very or extremely important the science lessons to be relevant to society in general. Despite this low expectation, 60%, respectively 68%, of the students consider the topics they study in actual Science lessons, respectively in IBSE lessons, are *very important* or *extremely important* to society.

Although, the results show that during IBSE activities the students had more opportunities to make suggestions to the teachers (77% have often, very often or always this opportunity) compared to usual Science lessons (62%), the students have fewer opportunities, in both types of lessons, than they would like (for 91% is important, very important or extremely important to have this opportunity).

A very interesting result was obtained at the last question related to the degree to which the students participate/would participate in Science/ideal Science lessons. Only 80% of the students would participate to ideal Science lessons *always* (40%), *very often* (16%) or *often* (24%). 71% participate in actual Science lessons *always*

(21%), *very often* (25%) or *often* (25%) and 78% have participated in IBSE activities *always* (34%), *very often* (26%) or *often* (18%).

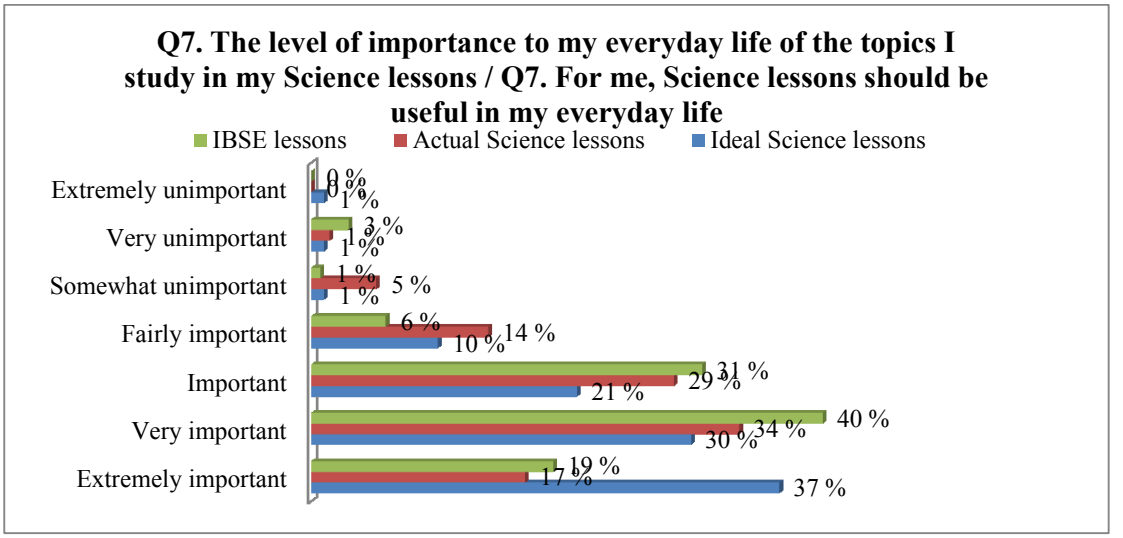

Fig. 3. Level of importance to students' everyday life of the topics they study in their Science lessons

3. Conclusions

The fact that 20% of the students would participate in **their ideal Science lesson** only *fairly often, sometimes* or *rarely,* proves once again that it's a necessity to change the approach in Science lessons in order to increase students' interest.

The findings of this study show that for primary school level students it is important to participate to enjoyable Science lessons, to understand the subject matter, to participate to Science lessons that are useful in their everyday life, etc. Overall, the IBSE Science lessons proved to be more enjoyable and relevant, from different aspects, for young students than usual Science lessons.

Acknowledgements

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