Self-Regulation Skills in Experimental Activities. The Case of the 9th Grade Romanian pupils.

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Abstract

Self-regulated learning refers to the pupils' ability to exercise an active, cognitive, motivational and behavioral control of learning, and is of high importance in helping pupils to better understand the content of text and in transferring learning from one context to another. Self regulated learning could be promoted through experiments and scientific investigations during Science lessons. Experimental activities, as usually performed in the school practice in Romania, involve making the experiment by pupils, under the direct guidance (verbally or through worksheets) of the teacher, or observing experiments performed by the teacher. The present study aims to identify the extent in which experiments and scientific investigations promote the self-regulation skills of 15 years old Romanian pupils. A written survey was completed by 142 pupils aged 15 years old. The participants' answers revealed the reduced concern for developing students' abilities, for establish independently learning goals and for preparing independently the action (planning, the selection of strategies). However, even if the educational practices in the educational system in Romanian give a reduced importance to the active role of pupils, the participants' responses show that they value the usefulness of the experiment in natural sciences, and they have positive attitudes toward experimental activities.

1. Introduction

The importance given by researchers to self-regulation skills has increased once with the importance given to the student-centred instruction. The diminishing influence of the behaviouristic approach to learning facilitated the shift from the instruction focused on limiting the pupils' control over the learning process to the student-centred instruction. Student-centred instruction emphasizes the active role of pupils in the construction of knowledge and their control over learning. Hence, students can assume responsibility for important learning decisions such as choosing learning activities, monitoring and judging process [1]. Hesketh [2] noted that this shift has emerged, in part, due to the increasing complex tasks which humans have to perform in the various professional fields, tasks which could not be performed if pupils were trained in accordance with the behaviouristic perspective demands.

Researchers consider that self-regulation skills have a major influence upon pupils' academic performance, increasing their academic motivation and learning [3]. Pintrich [4] defined self-regulation skills as the ''active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behaviour, guided and constrained by their goals and the contextual features in the environment'' (p. 453). Pintrich's general framework of self-regulation skills includes four phases: planning and activation, monitorization, control and reaction and reflection [5]. The first phase, planning and activation, involves the regulation of goals, prior content knowledge, and metacognitive knowledge. The second phase, monitoring, concerns the awareness of one's actions and outcomes. The third phase involves the cognitive and metacognitive activities that pupils use for adapting and changing their cognitions. Finally, the last phase includes judgements, attributions and self-evaluations of performance [5].

Some researchers consider that in effective schools and families' self-regulation skills emerge naturally [6]. However, explicit training is often considered to be the most effective way for developing and enhancing pupils' self-regulation skills. Such a training could be promoted through laboratory instruction, which has been proved to hold a significant role in science education if supports pupils' active involvement [7].

2. Methodology

2.1 Purpose. The main goal of the present research is to investigate the extent in which experimental activities promote self-regulation skills in a sample of Romanian high school pupils. However, since there is research showing that attitudes toward science influence performance in this domain [8] [9] we include in our survey items for assessing pupils' attitudes toward experimental activities.

2.2 Participants. The present research was conducted with 214 nine grade pupils from three high schools in Romania. The high schools were all from the urban area, with the majority of pupils coming from families with middle socio-economic status (assessed through the educational level of parents). Males were slightly overrepresented in the study, the percent distribution of the variable sex being 56.7 for boys and 43.3 for girls.

2.3 Measures. The survey has four sections: one for demographic data (e.g. sex, age, school), one for assessing pupils' attitudes toward experimental activities, one for assessing pupils' self-regulation skills and one for assessing the focus of instruction (teacher-centred or student-centred). Excepting the demographic section, all items were measured on a 5 point scale ranging from 1 (does not suit me at all) to 5 (suits me very well). The alpha Cronbach of the scale is 0.86, for all 48 items.

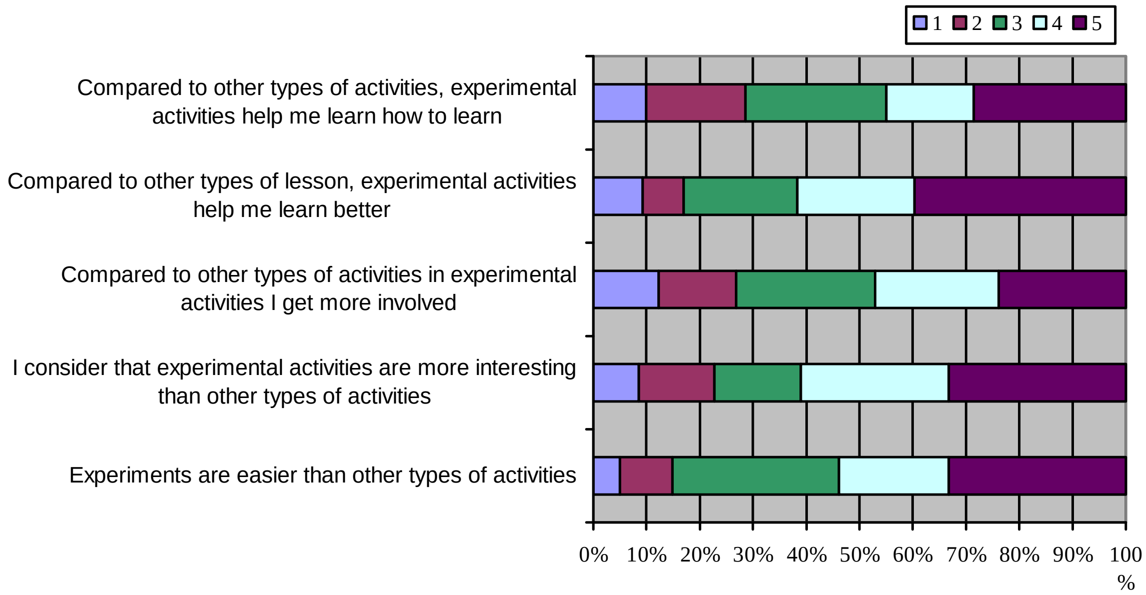
2.4 Procedure. The scale was completed by 9^{th} grade pupils from three schools in Romania, during the school hours, in a paper and pencil session. The sampling was not randomized since were chosen those schools in which the access was facilitated by knowing at least one teacher. However, pupils' participation was anonymous and voluntary.

3. Results

Data analysis is organized according to the three dimensions of the scale: attitudes toward experimental activities, self-regulation skills and the type of instruction. The normality tests performed with SPSS showed that our data distribution significantly deviate from the normal distribution. Accordingly, non-parametric statistics were employed for a series of tests (e.g., correlations tests).

The first question the present study aimed to answer target the relation between pupils' attitudes toward experimental activities, self-regulation skills and the type of learning (teacher-centred or student-centred). Firstly, the data analysis revealed that pupils have positive attitudes toward experimental activities. Figure 1 illustrates the items used for assessing attitudes toward experimental activities, items focused on the pupils' interest toward experimental activities, on their involvement in these kinds of activities and on the perceived effectiveness of experimental activities.

Fig. 1. Pupils' attitudes toward experimental activities



The 9th grade pupils from our study consider that experimental activities help them learn better, are more interesting than other types of activities, are easier than other activities and help them learn how to learn. A high percent (61.7%) of pupils answered 4 and 5 on the item "Compared to other types of lessons, experimental activities help me learn better". 61% of pupils consider experiments to be more interesting than other types of activities and 53.9% consider that experimental activities are more easier than other learning activities. Further, 45% of the participants consider that experimental activities help them learn how to learn.

The analysis concerning the relation between pupils' attitudes toward experimental activities, self-regulation skills and student-centred learning illustrates a positive correlation between pupils' attitudes and self-regulation skills. As can be seen in table 1, the only significant correlation is between pupils' attitudes toward experimental activities and self-regulation skills (0.40). Hence, pupils with positive attitudes have higher self-regulation skills.

Table 1. Correlations: attitudes toward experimental activities

	Attitudes toward experimental activities	Student-centred instruction	Self-regulation skills
Attitudes toward experimental activities	1.000	-.147	.410**

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Since the literature indicates that there is a positive association between positive attitudes and Science performance, we tested the correlations between these two variables for our 9th grade sample. Table 2 illustrates the main correlations between the items used to assess the attitudes toward experimental activities and performance in Science, assessed through the pupils' grades in Science school subjects (Physics, Chemistry and Biology).

Table 2. Correlations: attitudes toward experimental activities and Science performance

Items	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Experiments are easier than other types of activities	1.000	.560**	.360**	.505**	.227**	.150	.061	.058

2. I consider that experimental activities are more interesting than other types of activities	.560**	1.000	.337**	.447**	.328**	.170*	.125	.029
3. Compared to other types of activities in experimental activities I get more involved	.360**	.337**	1.000	.442**	.220**	.198*	.097	-.089
4. Compared to other types of lesson, experimental activities help me learn better	.505**	.447**	.442**	1.000	.465**	.255**	.108	.051
5. Compared to other types of activities, experimental activities help me learn how to learn	.227**	.328**	.220**	.465**	1.000	.071	-.032	-.036
6. Physics	.150	.170*	.198*	.255**	.071	1.000	.719**	.372**
7. Chemistry	.061	.125	.097	.108	-.032	.719**	1.000	.501**
8. Biology	.058	.029	-.089	.051	-.036	.372**	.501**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Data analysis revealed that there are no significant correlations between attitudes toward experimental activities and performance in Chemistry and Biology. However, significant correlations were identified between some items measuring attitudes toward experimental activities and performance in Physics. Hence, there is a significant correlation between the interest in experimental activities and Physics performance (0.17), between the involvement in experimental activities and Physics performance (0.19) and between the perceived efficacy of experimental activities and Physics performance (0.25). Nevertheless, the identified correlations are slight. There are also significant correlations between various items illustrated in table 2. For instance, there is a high correlation between the difficulty of experimental activities and the attractivity of these activities (0.56) and the perceived effectiveness of experimental activities (0.50). This means that pupils who consider experimental activities being more interesting are more likely to also consider that these activities help them learn better and to get more involved in such activities.

The analysis of self-regulation skills indicates that the 9th grade pupils from our study use their self-regulation skills in experimental activities. The means for the items which assess self-regulation skills range between 2.61 and 4.09, as illustrated in table 3. The mean for the item "I make the experiment by trial and error" is high (3.32), a percent of 46.1 pupils answering with 4 and 5 on this item.

Table 3. Average scores for the variable "self-regulation"

Self-regulation skills	Mean	Std. Deviation
Planning and activation	3.66	.901
Monitoring	3.44	.775
Control and regulation	3.17	.656
Reaction and reflection	3.61	.955

Regarding the type of learning promoted in the Romanian classrooms, there were two approaches assessed in the present study: the student-centred approach and the teacher-centred approach. In table 4 we illustrate the results of the analysis performed for these variables. The means for teacher-centered instruction are higher than the means for student-centred instruction. The higher difference is identified for the item regarding the choice of the Science experiments, illustrating that teachers choose the hypothesis of the experiment (mean 3.96) in a greater extent than pupils do (1.95).

Table 4. Average scores for the variable "type of learning"

Teacher-centred instruction	Std. Deviation	Mean		Std. Deviation	Student-centred instruction
The experimental hypothesis is chosen by the teacher	1.329	3.96	1.95	1.184	The experimental hypothesis is chosen by pupils

The devices needed for making an experiment are determined by teacher	1.447	3.51	2.43	1.416	The devices needed for making an experiment are determined by pupils
The teacher makes a sketch of the experiment	1.389	3.35	2.63	1.381	Pupils make a sketch of the experiment
The teacher describes the process for data gathering	1.431	3.10	2.90	1.436	Pupils describe the process for data gathering
The teacher indicates the process for data analyze	1.293	3.78	2.22	1.293	Pupils indicate the process for data analyze
The teacher specifies the conclusions	1.371	3.71	2.29	1.371	Pupils specify the conclusions

Although pupils possess self-regulation skills, the type of instruction promoted by teachers prevent them from using these skills during the experimental activities. Student-centred instruction negatively correlates with planning and activation and monitoring. The correlations between these variables are significant: 0.20 in the case of planning and activation and 0.22 in the case of monitoring (table 5). In addition, data illustrate a negative correlation between student-centred instruction and control and regulation and reaction and reflection. However, these correlations were shown to be insignificant.

Table 5. Correlations: self-regulation and student-centred instruction

Dimensions	Planning and activation	Monitoring	Control and regulation	Reaction and reflection
Student-centred instruction	-.206*	-.222**	-.001	-.164

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

4. Discussions and Conclusion

The main purpose of the present study was to the extent in which experiments and scientific investigations promote the self-regulation skills of 15 years old Romanian pupils. Further, we investigated if pupils' attitudes toward experimental activities correlate with self-regulation skills and with the type of educational instruction (teacher-centred or student-centred).

The results of the study shows that generally the 9^{th} grade pupils who participated in the research have positive attitudes toward experimental activities, believing that such activities allow them both to easily acquire knowledge and to improve their learning strategies. The results also indicate that most pupils apply self-regulation skills during experimental activities. However, in a teacher-centred instruction context, pupils have poor opportunities for improving their self-regulation skills through experimental activities. Thus, the correlations between self-regulation skills and student-centred instruction were negative. The present study did not confirm the positive correlations found in the literature between self-regulation skills and Science performance. We consider that this raises questions regarding the assessment methods employed by science teachers. It might be possible that the strategies used for assessing pupils' performance in science focus on memorizing the content of lesson and not on applying knowledge to relevant everyday life situations.

Given that the present research indicates that pupils have positive attitudes toward experimental activities and apply self-regulation skills in such activities, it remains unclear why educational orientation is mainly focused on teachers. The present findings suggest that the use of self-regulation skills should be promoted by science teachers, through engaging pupils in experimental activities which support them to actively engage in the construction of knowledge and to actively control their learning process. We consider that further research is needed in order to understand the causes of creating poor opportunities for using self-regulation skills in experimental activities.

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