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SCIENCE EXPERIMENTAL SKILLS

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Abstract:- The paper presents significant developmental aspects of the students' science experimental skills in science education. Science experimental skills are briefly described and classified. Authors put the accent on the structure of regulation phases within acquiring of science experimental skills. Experimental skills go through quite rapid development within students' school attendance from the primary up to secondary school. The aim of research is level measuring of acquiring these skills during students' experimental skills development.

Students in primary school are not able to reach all developmental stages. All developmental stages of acquiring science experimental skills are achieved by students at first on upper secondary school. Results are presented as exemplified by concrete science experimental skill: observation and measuring of temperature. The presentation is supplemented by original science experiments.

Keywords: Science Experimental Skills, Acquiring Of Science Experimental Skills, Development.

I INTRODUCTION

We can divide science experimentation into the following three levels (Trna, 2005):

Scientific experimentation-ascientist realisation of scientific experiments.

Teacher's school experimentation–ateacher view of school science experiments.

Student's school experimentation-a student view of school science experiments.

The differences between these three levels of science experimentation are not always fully understood and realised in practice. A typical view of scientific experimentation is a natural process incited synthetically in a laboratory within controlled conditions and its objective is the cognition of new phenomenon or natural patterns not yet known. The science school experiment however has another objective – the educational cognition of a phenomenon, or natural patterns which have already been discovered, but which if presented in a problem solving format, are unknown to the student. A significant difference also exists between students' and teacher's school science experimentation. Students perceive a teacher's demonstration experiment as passive, usually only to watch and hear, but possible to be involved in answering questions related to cognition. If, however, the students can do the experiment by themselves, they undertake it with all senses and - what is very important – the experiment is actively realised by the students (a psychomotor process). Teacher demonstration experiments can encourage the development of student's cognition, but students are able to acquire and develop the full range of skills only by their own activity, namely by school science experimentation. School science experimentation is also a very strong source of students' cognitive motivation (Trna & Trnova, 2004). Science teachers need to be aware of detailed information about the role of experimentation in science education (Royer, Cisero & Carlo, 1993). They not only need knowledge about the conceptual understanding associated with the experiment, but also, importantly, they need to acquire the teaching skill to accompany the use of experiments for student learning.

Science Experimental Skills

Cognitive-psychological educational theories which have their fundamentals in cognitive psychology findings (J.Piaget, G.Bachelard,etc.) emphasise the interaction between the curriculum, students and nature. In the sphere of science education outcomes from such theoretical bases are seen as the need to construct approaches through the student's own participation in cognition. This student's own active cognition of both the world and himself consists mainly of observation and experimentation. Observational and experimental skills together form a fundamental educational objective of science.

Science experimental skills are regarded as psychomotors kills and consist of the following:

Sensual part (reactingtooptic,acousticand tactile stimuli and information),

Intellectual part (planning psychomotor skill realisation; making decision of task solution approach inciting to psychomotor activity; choosing the optimal problem solution which includes kinetic activity; etc.),

Kinetic part (direction and extent of movement, speed and duration of movement, intensity of movement).

Students' science experimental skills are a significant part of science education. They have a very complicated structure in contrast to knowledge. Thus their acquisition within lessons is acomplicated process which deserved did acticelaboration.

Classification of Science Experimental Process Skills

Students 'science process skills can be classified as follows:

Experiment designing and planning.

Experimental apparatus designing.

Experimental apparatus formation and examination.

Development of an experimental procedure.

Data collection and presentation in appropriate format (observation, reading instruments and presentation of results with appropriate accuracy, replication of observations and significant figures).

Analysis of experimental results.

The classification of science process skills is useful for more accurate realisation of educational aims. However we need to determine the set of common principles required for the successful acquisition of all science process skills.

Development of Science Experimental Process Skills

Science process skills go through quite a rapid development within students' school attendance from the primary up to the tertiary level. These skills go through several stages within an individual's ontogenesis. These stages and their level depend on the measure of astudent's personality development (development of kinetic and rational skills, etc.). We can demonstrate skill development patterns as exemplified by science processs kills.

Students' science process skills have their own structure and phases of development (Svec,1998):

Integration stage during which the process skills are integrated into a skill structure: Solving of a problem situation, problem tasks and projects containing science experiments.

These stages of acquiring science process skills proceed within lessons from the primary grade up to the tertiary level of education. However pedagogical-psychological patterns for this development need to be applied in science education. The aim of this study is to measure the levels of student acquisition of science process skills during the developmental process.

Methodology

Our findings are presented as exemplified by concrete experimental science skills through the observation and measuring of temperature. The study is based on the observation of students' school activities during the acquiring of experimental science process skills in lessons. Aquestionnaire for teachers was also developed.

Worksheets for students

The activities undertaken by the students during the observation were guided by means of worksheets. The activities involved were measuring natural quantities. The structure of the worksheets corresponded to the stage of the learned experimental skill. The worksheets were divided into two parts. The first part involved a motivation stage plus an orientation to acquiring skills stage:

Complex problem task or project; the skill of measuring quantities had to be creatively integrated into a structure of other skills and used as a complex skill. It was essential to choose or suggest the appropriate method of measuring, make or design a suitable measuring apparatus, interpretthe obtained data and devise its processing.

The content and level of difficulty of the three tasks given were processed at three age categories:

Primary school level :age of8 –11years.

Lower secondary school level:ageof12–15years.

Upper secondary school level:ageof16-19years.

Results

We analysed about one hundred student completed worksheets at every age level. The percento currence of successful solution of tasks is presented in table1.

Conclusion

The five stages for acquiring science process skills, put forward by Svec (1998) have been shown to be attainable and worthy of greater attention. By carefully relating the seskills to the stages of a student's development, it is possible to build up a strong base for the acquisition of interdisciplinary problem solving skills.

Students' acquisition of experimental skills is a significant part of scientific education. Their acquisition involves a very complicated structure in contrast to knowledge and thus needs didactic elaboration. In addition, experimental skills have the potential to undergo rapid development during a student's time at school from the first stage of basic school up to graduation.

Preparation of science teachers to handle the development of students' experimental skills has yet to be solved. This concerns development of pedagogical skills evolving within university studies and especially with in his/her work at school (Epitropova, 2004).Creation of these

teachers' pedagogical skills needs to be an integral and systematic part of a curriculum of science teachers' university training and in-service preparation.

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