EVALUATION OF TEACHING STRATEGIES FOR CRITICAL THINKING DEVELOPMENT IN THE SUBJECT OF TECHNOLOGY

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Abstract
Contemporary educational tendencies in Slovakia aim towards transformation of traditional encyclopedic memorising into practice-oriented and creative learning with emphasis on critical thinking development. Teachers and their professional competencies in educational strategy implementation play an important role in the development of critical thinking. The objective of this contribution is to present the AAA method, a specific method for evaluating teacher competencies, in the subject of Technology. The AAA method researches one or several teaching activities by annotation, analysis and alteration of various teaching situations from video hospitalitations. This article focuses on the teaching strategies applied by teachers in order to meet the established teaching goals with emphasis on the development of critical thinking in a Technology lesson themed Electric energy, Electric circuits.

Keywords: AAA method, strategies, critical thinking, subject of Technology.

1 INTRODUCTION
This article is a part of the AVV-15-0368 project called Practical Training in the Centre of Field Didactics, the Field Didactics in the Centre of Practical Training, which aims to identify the teaching strategies for developing critical and creative thinking in pupils [1]. This project is currently in the phase of deep analysis and methodological materials being designed in the form of didactic situations and teaching strategies of particular subjects applying the psycho didactic knowledge from the subject field didactics. In our case it is the area of technical subjects. In this article, we point out the selected methodological teaching materials in the subject of Technology, which will later serve as educational resources for future teachers of technical subjects, as well, as a means of teacher competency evaluation in critical and creative thinking teaching strategy implementation.

2 THE AAA METHOD (ANNOTATION-ANALYSIS-ALTERATION)
"Education is a complex process of teaching (teacher’s purposeful, systematic, organised activity) and learning (willful or even unintentional personality development of the pupil) in school environment [2]. Education quality has been, in recent years, described as a process in which the key factor is the teacher and their individual competencies that show in a specific way of managing the lesson and organising the pupils’ activities, thus in strategies focusing on processing of materials by students [3], as well, as critical thinking development [4, 5]. Strategies are methodological approaches that the teacher picks in order to meet the educational goals in accordance with the learning strategies of pupils and societal interests [6]. They are observable, measurable, partial steps or processes that in a meaningful arrangement create an entire process – a strategy [7].
When choosing the most suitable teaching strategies the key factor is the teacher and their professional competencies. Evaluation of these competencies, along with teachers’ and pupils’ results, has been the focus of educational politics of nearly every country, as governing bodies try to increase education quality based on these [8]. Class inspection is one of the most popular methods of evaluating teaching competencies. This includes:

- Inspector or headmaster lesson visitation for evaluation of teachers’ professional competencies;
- Visitation of a student - future teacher, in order to observe and gain pedagogical experience [9].

According to the theoretical bases of recent studies, video inspection can also be included in this division. This type of inspection builds on deep analysis of the whole lesson or selected parts of the lesson footage. This is known as the inspection video study [10]. The concept of this inspection comes from the practical shift in socio-humanistic sciences defined by two basic theses:

1 Practice is the basis of theory;
2 Theory should be practice-oriented [11].

The principle of this inspection lies in 3 methodological steps: annotation, analysis, alteration (the AAA method or the 3A method). Annotation represents a brief description of the inspected lesson, with emphasis on the topic, goals, content, pupil and teacher activity, sequence of the material and teaching aids. Analysis focuses closely on the teaching strategies applied in order to meet the teaching goals, in this case, the development of critical thinking. Alteration is the hypothetical suggestion for improvement, adjustment or change within the teaching situation, along with a discussion [8]. We tried to apply this method in Technology lesson class and to evaluate the professional competencies of the teacher based on what teaching strategies he applied in order to develop critical thinking.

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The basis of this evaluation were the strategies formulated in relation to multiple subjects [12]:

1. Self-regulation development strategies,
2. Strategies for developing systematic and interpretation skills,
3. Argumentation strategies,
4. Deduction and problem solving strategies,
5. Strategies for evaluation development,
6. Strategies for developing reading skills,

And strategies in the subject of Technology [13]:

1. to lead the students towards gaining basic user skills in various fields of human activity,
2. to use various teaching aids,
3. to use various technical materials and equipment,
4. to create situations that induce the need for new designs, apply product creation processes in order to induce creativity,
5. to induce experimentation with ideas, materials, technology and equipment,
6. to apply small group activities,
7. to develop the ability within pupils to take responsibility for individual or group project results,
8. to inform pupils about current labour market requirements and recent development in technology,
9. to shape the teaching content according to B. S. Bloom's taxonomy,
10. to apply project teaching,
11. to apply problem solving teaching,
12. to apply methods for developing creativity.

In order to evaluate the strategies for critical thinking development, a video footage from a lesson in Technology was used for inspection. Technology curriculum for lower secondary school (5th and 9th grade) is mainly oriented towards development of technical thinking and creativity through practical activities. The content of this subject complements the general knowledge of pupils and adds a component for adaptation to practical life and labour market. The pupils gain knowledge, work habits, safety and health protection habits while working with materials and equipment. Besides the set of complex activities for pupils, usage of advanced technologies and importance of both individual and team work in learning, the emphasis is also put on the improvement of critical thinking in the current National Education Programme of the Slovak Republic for the school subject Technology at the level of lower secondary education [14].

4 ANNOTATION

The lesson took place in the 6th grade of St. Gorazd elementary school in Nitra in a class of 10 students. This basic type lesson was focused on the area of Human and Labour, with the topic Electric Energy &
Electric Circuits. The content of the lesson was designed with focus on the performance standards of this educational area and subarea:

- to design a serial and parallel bulb connection according to the scheme,
- connect the diode in conducting and inverse direction,

The lesson consisted of initial greeting, absence check-up, revision of previous materials on electric energy, which involved a basic electric circuit scheme. Afterwards the teacher bridged over to the new curriculum, the aim of which was to familiarize the pupils with serial and parallel light bulb circuit connection. The teacher noted the new information on the board along with graphic explanations. Pupils took notes. Further activity imparted practical application of the gained knowledge in working with the electric circuit building kit. Pupils followed the teacher’s instructions along with the instructions in workbooks (figure 1). 3 of the workbook activities were focused on construction of serial electric connection of a light bulb and a small motor, parallel electric connection of a light bulb and a small motor and a LED diode electric circuit.

During the realization of practical tasks, the teacher constantly checked on pupils and their progress, individually approached them and provided guidance. Last task was an exception. Here the pupils were left to complete the task without instructions. The teacher waited while the pupils find out how the diode needs to be connected. After completion of the last task, the new findings were again noted down on the board and in pupils’ notebooks. Afterwards, the teacher provided additional explanation of the diode symbol. The last part of the lesson was the overall revision of newly gained information via teacher’s questions and final evaluation of pupils’ work.

5 ANALYSIS

The education activity was realized through teaching strategies with emphasis on goals the teacher tried to achieve throughout the lesson. The lesson consisted of motivational, exposure, fixation and diagnostic part. All of them were well balanced and orderly.

In the motivational part the teacher greeted the pupils and after absence check-up, informed the pupils about the lesson topic which was Electric Energy & Electric Circuits. He sked questions in order to induce attention and activity of the pupils. They also thoroughly revised the materials from the last lesson about basic electric circuit, which contributed to better systematization of the new material. Teacher combined written and verbal forms of revision (questions and graphical illustration of the electric circuit on the board). He asked questions inducing thinking, such as: Why? What if? He provided feedback to pupils’ answers.

In connection with the previous materials, the teacher continued to exposition part focused on conveying the new curriculum content. He explained new information and linked each to everyday life situations. Using occasional questions, he involved pupils, thus encouraging them to actively interpret the new material. He made sure he, as well as the pupils, used correct terminology. He graphically demonstrated the most relevant information and the pupils took notes. As a part of interpreting the new material, the teacher applied the perception of objects by demonstrating real aids related to the subject (light, lamp, diode, switch, etc.).
One of the objectives of the subject of Technology is to provide pupils with knowledge through practical activities. In accordance with this goal, the teacher induced independent practical application of newly acquired information by using Boffin electronic building kits. Given the subject matter, it is important to inform the pupils about the basic health and safety principles, which the teacher did before designing the electric circuit. Given that the pupils had already had experience with the building kit, the teacher did not demonstrate the design process.

In order to achieve the set goals, the teacher developed a didactic tool for pupils, the workbook. It showed schemes of electric circuits that were introduced to pupils previously. In order to get attention, the teacher changed some of the components in the schemes. In tasks 1 and 2 (figure 2) the pupils had to connect the light bulb and a little motor and in task 3 they had to connect a diode. The pupils worked in pairs which induced communication and cooperation. The teacher did not intervene with the activity, however, he provided guidance and encouragement. After completion of each task, he provided feedback and commended them for well done work. Pupils showed interest in this type of learning and resolved the tasks without major problems.

![Figure 2. Resolution of tasks 1 and 2.](image)

Workbook task number three was a simple problem task (figure 3). It focused on correct diode connection in a circuit. The teacher left the pupils to resolve the task individually in pairs, without instructions. Out of 5 pairs, 2 resolved the task correctly by carefully studying the diode symbol and deducing the correct connection. The rest of the students resolved the task on second try or with teacher’s help.

![Figure 3. Resolution of task 3.](image)

From the task result and after a discussion, the teacher and the pupils deduced a definition that was then noted on the board and in pupils’ notebooks. At the end of this task, the teacher asked the pupils to safely pack up the building kit and smoothly continued to the diagnostic part of the lesson.

In this part the teacher, again, used questions to induce revision and fixation of the gained knowledge and information. The teacher asked open and closed questions with positive and negative answers, as well as, questions for comprehension and retention. There were no questions aimed at higher thought processes.

In the diagnostic part, the teacher verbally evaluated the pupils and ended the lesson.

The footage analysis has shown that teaching strategies applied by the teacher in the lesson on Electric Energy & Electric Circuits were suitable and efficient in both exposition and fixation part of the lesson. Its efficiency has shown in the main part of the lesson – the pupils showed joy when working with the
electric circuit building kit. Also, in the final part of the lesson the pupils answered all of the revision questions without trouble.

6 ALTERATION

Suggestions for improvement:

As mentioned in the analysis, the lesson had begun with greeting and revision of past material without motivation. Per the tight time schedule, it is understandable why the teacher chose this approach, however, for critical thinking development it is necessary to apply motivational components in the lesson, especially to induce interior motivation, which further induces curiosity and the quest for knowledge. Therefore, we have suggested to involve a simple problem task e.g. a picture of an incorrectly connected electric circuit. After a deep analysis (application of B.S. Bloom’s taxonomy) the pupils and the teacher reach a higher stage of learning – is the electric circuit in the picture connected correctly? If not, why? What adjustments do you suggest? How would you add another component to this circuit? Etc. The teacher could also include a demonstrative motivational item e.g. a diode or two light bulbs, and afterwards induce a discussion applying B.S Bloom’s taxonomy – are you able to name the component? What is its use and where is it applicable? How do you connect it to the existing circuit correctly? What would happen if you connected the component incorrectly? How can you verify that? Etc.

The revision of past materials was done in a large group at the beginning of, as well as, the end of the lesson. These situations allow that not everybody joins the revision process. Despite the teacher’s attempt to induce interaction with all of the pupils, it was obvious the large group revision did not suit everybody. Some pupils had trouble expressing their opinions in front of the class. For activity variety, we suggest to combine task types in every part of the lesson. Furthermore, we suggest to include individual written revision of some of the lesson content, e.g. the electric circuit scheme. Also, final revision could be done in smaller groups of 4-5 for instance using a concept map (applying methods for critical development development). Critical thinking can be developed through various activities. We have suggested a concept map in order to fixate and systematize the pupils’ knowledge of electric circuits.

Activity evaluation came only from the teacher. We suggest to involve the pupils in evaluation. For example, at the end of the lesson, we would include a short discussion/interview with students: what have you accomplished in this lesson? Have you learned anything new? Have you fixed some of your previous incorrect knowledge? Is there something specific related to this topic that you would like to know more about? Feedback from pupils not only develops their critical thinking (and critical self-evaluation) and helps to express their opinions, it also helps the teacher in self-evaluation and more efficient lesson plan preparation.

7 CONCLUSIONS

The objective of this study, was to emphasize the option of evaluating teacher’s professional competencies in implementing suitable teaching strategies for critical thinking development using the AAA method. The output of this research is the methodological material in the subject of Technology, which along with similar materials will be a part of the database of didactic situations in pedagogical practice arising from further APVV project objectives.

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