TEACHING STRATEGIES IN PREGRADUATE TEACHER TRAINING OF TECHNICAL SUBJECTS

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Abstract

The issue of developing critical and creative thinking is currently an important socio-scientific phenomenon in Slovakia. Consequently, requirements increase for improvement of pregraduate training of future teachers. Graduates should be equipped with essential competencies and strategies that impact the development of personality and critical thinking within pupils. This paper describes the partial results of the research project APVV-15-0368 - Practical Training in the Centre of Field Didactics, the Field Didactics in the Centre of Practical Training, the objective of which was to find what critical/creative thinking strategies within technical subjects on lower secondary stage are considered important by students (future teachers of technical subjects) and to what extent these are being applied throughout their teaching practice. The results have shown that future teachers mainly focus on practical activities applying various technical materials and tools, they use a spectrum of teaching resources and encourage the pupils to experiment with ideas, techniques, materials, and technology. Furthermore, future teachers lead pupils to take responsibility for the outcomes of their work. This article builds on the previous study of Critical and Creative Thinking Strategies in Teaching Technical Subjects which focuses on the practical application of said strategies.

Keywords: Future teachers, critical thinking, creative thinking, practice, technical subjects.

1 INTRODUCTION

Critical and creative thinking may be characterized as the ability to analyse and synthesize arguments, and draw conclusions based on induction and deduction. It is also the ability to assess, evaluate, take decisions and solve problems based on gained knowledge and experience. The results of this ability have been virtually unknown, however, at the same time socially, culturally, technically, spiritually, and materially valuable.

The two phenomena are in a reciprocal relationship, which according to many authors is crucial, if pupils are to develop these areas [1], [2]. Many conditions influence the development of critical and creative thinking, as it is a very complex process [3]. The basic conditions are the development of knowledge, critically and creatively thinking teacher and the shift from a traditional school education based on memorising knowledge to a humanistic and creative approach where pupil is fully dynamic and active.

2 BACKGROUND OF THE STUDY

Technology is a compulsory school subject taught in Slovakia at the lower level of secondary education (ISCED 2, in Slovak conditions grades 5 – 9 of a primary school) with a time allocation of 1 lesson per week in each of the grades 6 – 9). According to the National Education Programme [4] the purpose of this school subject is to form practical work habits of students, i.e. to complete their general education with a component necessary for one’s integration into the real practical life and the labour market, too. Through practice oriented activities, students acquire safe work habits and learn to assess risk when working with various materials and tools. Furthermore, students acquire basic administrative and commercial skills such as time and resource management.

The main objectives of education in this subject is the development of:

- technical creativity, which [5] is defined as the activity of students related to technology, characterized by full concentration of students on the technological object of education;
- technological literacy including basic functional skills and critical thinking, constructive work habits, a set of generalized procedures for working with technology, actual technological capability, key interpersonal and teamwork skills, and the ability to learn independently [6].
• technical thinking (complex of thought operations, particularly the thought analysis of the work result expectations, retaining and activating previously acquired knowledge, skills and experiences, which may be used to solve a particular given problem, in construction, production process, and the synthesis of all the matters by means of which the solver reaches the project design, in other words the construction solution and product processing [7];

• spatial imagination, i.e. the ability to imagine/visualise features of three-dimensional objects – their shape, position, size, location [8];

• knowledge and skills related to technology, technical materials and tools for their processing.

3 METHODOLOGY

The National Education Programme of Slovak Republic in the subject of Technology [4] for lower secondary education level, effective since 2015, reflects, apart from more complex activities and technology, emphasis on team and solitary work, the ability of critical and creative thinking. It rates first in the areas of general education goals, as well as key competencies for lifelong learning. The question remains, to what extent do teachers and future teachers apply these strategies in their teaching practice? Are current and future teachers properly prepared for these changes? Do they have enough opportunities to exercise critical and creative thinking in their teaching process? Answers to these and many more questions were further investigated through a study carried out within the framework of the project APVV-15-0368 Practice in the Centre of the Subject Field Didactics, Subject Field Didactics in the Centre of Preparation for Practice. The main objective of this project is to identify adaptive teaching strategies that implement a cognitive-oriented approach for developing critical and creative thinking in pupils, as well as other key psycho didactic topics and strategies and their implementation in practical pregraduate preparation of secondary level teachers through excellent practical preparation centre. Based on this goal, we created 2 surveys for our current and future teachers of Technology. Each consisted of 3 parts (Figure 1).

Due to the defined scope of the paper, we will, next, deal with the analysis of selected results of the survey for teachers – part II. and analysis of selected results of survey for students - part I. By comparing the presented parts, we have gained a comprehensive view of the application of individual strategies of students in technical subjects evaluated from the perspective of the teacher as well as from the perspective of the students themselves. These parts of the survey were distributed electronically to selected primary and secondary technical schools.
4 RESULTS

4.1 Implementation of Technically Oriented Strategies for Critical and Creative Thinking by Students - Assessment of the Training Teacher

The 2nd part of the teacher survey consisted of 25 closed items. Respondents could express the frequency of strategy application numerically, using a 6 degree scale, with 6 - 5 meaning applying the strategy each lesson, 4 - 3 not applying the strategy each lesson, 2 - not at all. Also, the importance that respondents attribute to individual strategies is expressed using this scale as well, 6 - 5 meaning respondent considered the strategy to be extremely important, 4 - 3 meaning not very important, and 2 - 1 meaning unimportant.

25 training teachers took part in the electronic survey, of which 10 teachers (40%) teach at lower secondary level, 11 teachers (44%) at secondary technical schools and 4 teachers (16%) at secondary vocational schools. In this part of the supervising teacher survey evaluation, we focused on verifying the application of technically oriented critical and creative thinking strategies by students, during their teaching practice within technically oriented subjects (Table 1, Figure 2).

Table 1 Implementation of Technically Oriented Strategies for Critical and Creative Thinking by Students

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Figure 2 Implementation of Technically Oriented Strategies for Critical and Creative Thinking by Students – Evaluation of Supervising Teacher

- A. Implementation of various teaching aid resources
- B. Practical activities with technical materials and equipment
- C. Creation of situations in which pupils can design and apply a production process
- D. Experimentation with ideas, materials, technology and techniques
- E. Application of creative ideas when resolving tasks
- F. Taking responsibility for one’s work and work results
From the results of this analysis in Figure 2, following conclusions arise: according to supervising teachers, (64%), students apply practical activities with different materials and tools each lesson (scale 6), they apply various teaching aid resources (48%), and lead pupils to account for the quality of their work (44%). 36% of supervising teachers believe that students create situations on each lesson in which pupils can design and implement a product creation process, where they are able to apply creative and proprietary solutions (32%), and lead pupils to experiment with ideas, materials, technologies and techniques (28%). The strategy to apply creative and proprietary solutions and to take responsibility for the quality of own work, both on the scale 5, have the same, relatively significant, percentage (36%). From this we conclude that students plan and manage the teaching process in the spirit of active learning and critical and creative thinking. According to teachers, students also lead pupils to be able to critically analyze and assess not only their thoughts, but also their practical activities. They use a variety of resources to stimulate creativity, curiosity and activity of pupils, leading to responsibility for their work and its results.

Table 2 Reflection of the Training Teacher on the Application of Technically Oriented Strategies for Critical and Creative Thinking by Students

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Figure 3 Evaluation of the Importance of Students’ Application of Technically-Oriented Critical and Creative Thinking Strategies from The Perspective Of Teachers
From analyzing the importance of applying these strategies by pupils, from the perspective of the supervising teacher (Figure 3), we conclude that they find very important (6-5) the following: technical activities with technical materials (84%), responsibility for one's work and the results of their work (84%), the use of different teaching resources (76%), the application of creative design ideas for work activities (68%), creating situations in which pupils can design and implement a production process (64%) and experimenting with ideas, materials, technologies and techniques (64%).

Only a small percentage of teachers of technical subjects attribute very little to no significance (2-1) to technical strategies, such as creating situations in which pupils can design and implement a production process (8%), practical activities with technical materials and tools (4%), experimenting with ideas, materials, technology and techniques (4%), and applying creative ideas (4%). In spite of the small number of teachers who attribute very little importance to these strategies, this finding is, in our view, unsatisfactory, since the main objective of technically oriented subjects is, above all, to apply creative activities which help to develop technical thinking and skills in working with different materials and tools. How do these teachers achieve the desired goals and key competencies?

By comparing the results in Figures 2 and 3, we may conclude, that teaching strategies that teachers consider most important (practical activities with, use of different resources of teaching aids, the application of creativity and responsibility in practical activities, etc.), are widely implemented in the teaching process during their teaching practice.

In the next part of the verification of technically oriented strategies of critical and creative thinking, we focused on the self-assessment of students in terms of the above-mentioned strategies.

4.2 Implementation of Technically Oriented Strategies for Critical Thinking – Self-Reflection of Students

The construction of the 1st part of the survey for students, future teachers, also consisted of 25 closed items. Students from Department of Technology and Information Technologies at Constantine the Philosopher University in Nitra, participated in the questionnaire survey:

- Teaching techniques in combination 1.1.2 Teaching professional subjects and practical training;
- Practical training in the field 1.1.2 Teaching professional subjects and practical training;
- Further education students.

The survey was distributed to the students personally in print form, thus guaranteeing 100% return. Of the total of 31 students, 39% were freshmen, 39% were Master degree students and 22% were graduate students.

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Table 3 Application of Strategies for Critical and Creative Thinking - Self-Reflection of Students
The results in Figure 4 show that students within the framework of self-reflection state they use traditional strategies and forms of teaching resulting from the content of the subject and the structure of the lesson. Thus, most frequently (6-5), they focus on the application of various teaching aid resources, practical activities with technical materials, tools, the creation of own ideas, problem solving, etc.

Surprisingly, however, 48% students claim they do not apply the strategies of experimenting with ideas, materials, and technologies on each lesson. 32% of students also mentioned this strategy on scale 2, which suggests a very rare application of creative activity to develop creativity and technical thinking. More than 48% put practical activities with technical materials and tools on scale 3 and more than 45% put the use of different teaching resources on this scale, as well.

5 CONCLUSIONS

According to teachers’ findings, in the area of technically oriented critical and creative thinking strategies, students prefer practical activities during the lesson, using technical materials that they can design themselves applying their imagination and creativity. Furthermore, students quite frequently apply various aids and other methods of developing creativity and activity. Here, the importance that teachers’ attribute to these strategies and the consistency of their application is on the same level.

The subsequent comparison of teachers’ student evaluation and the results of students’ self-reflection shows a discrepancy, especially in the frequency of strategy application by pupils.

While according to teachers, students apply many critical and creative thinking strategies on the scale of 6-5 (every-almost every lesson), students believe this is otherwise. 42% of the pupils state they apply 3 main strategies on the scale 6-5 (using various aids and resources, practical activities using technical materials and equipment, application of creative ideas).

This may be due to the fact that students often take on the traditional ways of teaching management and teaching strategies from their teachers, whether due to their own beliefs, or because they are led to do so by their supervising teachers [10]. However, such “copying” of the teaching method may prevent students from applying their own ways of teaching, new ideas [11] or other strategies...
supporting the development of critical and creative thinking. This may have resulted in such a significant percentage of strategies like experimenting with ideas, materials, technologies and techniques, applying creative forms of work to develop creativity and technical thinking, as well as product quality responsibility in students’ self-reflection across scale 4 to 2, i.e., the strategies are only rarely applied.

We can assume that the significant differences that occurred in teacher and student assessments could be for a number of reasons, such as: non-critical assessment by teachers, or, on the contrary, overly critical self-assessment by students. This could also be due to lack of awareness of critical and creative thinking, which could result in misinterpretation of the question or scale by both teachers and students. If students’ overall self-assessment was consistent with those of training teachers, we would assume the undergraduate student training for developing pupils’ critical and creative thinking is inadequate. However, this is not the case, based on a positive assessment of the trainee teachers. Therefore, this difference can be seen as a consequence of the above-mentioned copying of the traditional teaching strategies.

In conclusion, it has been shown that teachers themselves prefer to use the above mentioned strategies as often as possible, whilst the students try to gradually increase the frequency of their application in technically oriented lessons.

ACKNOWLEDGEMENTS

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REFERENCES