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CREATING A-HA MOMENTS IN TEACHING PRACTICE. ROUTINE VERSUS ADAPTIVE METACOGNITIVE BEHAVIORS IN TEACHERS

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Abstract: *This paper focuses on adaptive metacognition research in Romanian teachers in upper secondary education. The article describes the results of a hybrid quasi-experimental research study conducted on high school teachers. The research was conducted in three phases: profiling teachers regarding their level of metacognitive competence, involving teachers in metacognitive training activities, and investigating the changes in teachers' adaptive behavior. The initial sample of teachers was divided into two groups, namely the control and treatment group. The subjects in treatment condition were engaged in a metacognitive approach based on erotetic techniques. The results of the research express that adaptive metacognition improves by using scaffolding tools such as erotetic matrix. The article discusses the research results and presents two case studies in order to describe the nature of metacognitive behaviors in teachers. We conclude the paper by presenting the A-HA approach, designed to help teachers to improve their metacognitive capabilities.*

Keywords: *adaptive metacognition, regulation, metacognitive strategies, teacher training*

1. INTRODUCTION

Over the passing time, metacognition's relevance in the field of education increased and propelled the concept among the most forceful concepts in educational research area. The term metacognition refers to a general human ability to think about one's own thinking. The object of metacognition is regular thinking. This capacity is thought to reflect a wide range of semi-independent faculties which allow individuals to form representations of their own mental states and the mental states of others [5]. In a traditional way, research has focused more on students' metacognitive capabilities rather than those of teachers. In this article we propose a switch on teachers' metacognition.

Teachers engage in complex mental activity as they monitor and regulate their thinking as they teach [1]. In addition, teachers are strategic as they apply instruction, solve problems that arise in the classroom, and adjust their teaching to individual student differences [2]. Despite this wide accepted idea, little research has specifically examined teachers' metacognition, especially in Romania. Lin, Scwartz, and Hatano [4] point that conventional applications of metacognition must be reanalyzed when researching teachers' metacognition. The rationale behind this affirmation focus on the

complexity and uniqueness of the teaching activity. In the context of teaching, solving problems requires time and profound reflexing. Further, finding a good solution for a specific problem depends on successfully blending competing values [4]. For instance, these values may refer to teacher, students, parents, school culture. Moreover, in traditional approaches of metacognition the object of metacognitive activity are individual thoughts and cognitive processes. In addition, teaching is challenged to adapt to environment and students' requests. Metacognitive literature names this suite of phenomena *adaptive teaching, reflective adaptation or adaptive metacognition*.

Adaptive metacognition involves both the adaptation of one's self and one's environment in response to a wide range of classroom variability, argue Lin and his collaborators [4]. Following a conceptualization proposed by Parsons, Davis, Scales, Williams and Kear [7] in the context of this paper adaptive teaching is defined as a teacher's action that was non-routine, proactive, thoughtful, and invented; included a change in professional knowledge or practice; and was done to meet the needs of instructional environment. These referred representations enable one to form, challenge, and revise ideas of what is believed, felt, dreamt of, learnt or feared in a number of rapidly evolving contexts [5]. Despite all these benefits, metacognition is not easy-to-research phenomenon.

According to Veenman [9], one of the reappearing problems with metacognition research is the "fuzziness" of the concept and its constituents. This fuzziness is not only due to a proliferation of terminologies. Researchers also debate on the constituents of the construct of metacognition and their interrelationships. Starting with Flavell and Brown (in the '70s), many authors often make a distinction between metacognitive knowledge and metacognitive regulation or management. The latter is sometimes referred to as executive or self-regulatory processes. Thus metacognition is not a very new concept in the field of education sciences, there is still a debate on the general or specific nature of metacognitive skills. Kuhn and Dean [3] explain that metacognition designates one's capacity to transfer a particular context-related strategy to another similar but new concept. Schraw [8] describes metacognition as a multidimensional set of general skills rather than domain specific.

The article consists of four sections as follows. The first one was dedicated to a brief review of the metacognitive literature. The second one presents the research design and methodology used to investigate adaptive metacognitive behaviors in high school teachers. We describe routine metacognitive behaviors and their instructional effects in the third section. The fourth section focuses on a set of methods and tools to stimulate adaptive metacognition and improve teacher quality.

2. RESEARCH DESIGN AND METHODOLOGY

2.1 Research problem statement and interrogations. If we assume that metacognitive competence is a core of teaching activity, the author's focus is to evaluate adaptive metacognitive behaviors in order to develop a set of methods and tools to scaffold adaptive instruction in classroom.

The interrogations guiding this study were as follows. I1: To what extend teachers use adaptive metacognitive strategies while teaching and interacting with students; I2: Adaptive metacognition in teachers can be improved through specific methods and activities?

2.2 Research objective. The main goal of the study was to develop a suite of tools to scaffold adaptive metacognition in teachers in upper secondary education.

2.3 Sample. The research sample included 122 Romanian teachers, in upper secondary education, residents both in urban and rural areas, from two counties (Giurgiu and Valcea) and the capital city. The sampling method followed a theoretical and realistic approach based on the criterion of relevance. The teachers were purposefully selected based on their experience in teaching (little or no experience, moderate, and high experience). We fully acknowledge that the sample may not be representative for the whole population of Romanian teachers.

2.4 Data collection procedures. The research was based on a quasi-experimental correlational design, implemented as follows. The pretest phase consisted in surveying the teachers in order to evaluate their initial level of metacognitive competence. A questionnaire was designed to serve this purpose. After the completion of the questionnaire, the subjects were divided randomly into two groups. Due to geographical distribution, the treatment group included 42 teachers, fewer than the control group (n = 45). 35 teachers refused to continue the research project. Both subjects from the treatment and control group (n = 21) participated in in-depth interviews aiming at identifying types of contexts and variables activating metacognitive behaviors.

A number of teachers in treatment group (n = 13) accepted to deliver a class by following a given scenario. The researcher designed different types of lesson plans according to teachers' domain of activity or discipline. One scenario type focused on blending digital educational content and traditional instruction. Another type of scenario was based on problem-based learning strategies and virtual learning environments. The third scenario type focused on collaborative learning in virtual learning environments. Teachers were told to follow the lesson plans and when they feel something is wrong or don't feel comfortable about the lesson's progress they can switch back to their own approach.

All the teachers in treatment and control groups participated in activities were they were asked to analyze a number of teaching situations and to provide solutions for those critical issues in class.

The profiling phase was followed by the training phase. Based on the results of the pretest inquiry, a set of metacognitive tools was designed, named *Tools for thinking.* A following section of the article will focus on these tools.

The last phase of the research project describes the posttest phase were both teachers in treatment and control groups followed the interview protocol and solved critical issues.

2.5. Research instruments. Metacognition can be assessed by many different methods and tools. Metacognitive literature often makes a distinction between on-line and off-line methods, depending on the time they are applied. Due to geographical and other limits, off-line methods were applied namely the COMEGAN-ro questionnaire and situational interview protocols. COMEGAN-ro questionnaire is a self-report questionnaire measuring metacognition on six scales: knowledge about persons, tasks, strategies and metacognitive planning, monitoring and regulation. The questionnaire comprises 36 Likert rated items: 6 items load on each scale. This research instrument was translated into Romanian, adapted and validated on teachers population, having a very good score of the internal consistency (Cronbach's alpha = .89, with positive inter item correlations). The original instrument was designed by Pallascio, Daniel, and Lafortune [6].

Unlike the COMEGAN-ro questionnaire, the interview protocols proposed prospective approaches, where subjects were invited to express their intentional behavior in different situations. In addition, routine and non-routine situations were presented to the teachers. The subjects proposed solutions for those issues or critical events [4].

The first routine situation described apathetic students, who say frequently they don't care about the lesson's subject. Another routine situation depicted disturbing students who are not paying attention to the teacher, talk to each other making noise. A non-routine

issue went on a student's reaction to a case study on human rights (a wide topic ranging multiple disciplines). The student says to the teacher that human rights should not exist because people are not equal and those living in rural areas or poor countries have no chance to succeed anyway. Investing in poor people is a waste of resources, points out the student. The fourth non-routine situation refers to a moment when a student becomes upset because of a poor grade and says to the teacher it is all his or her fault. The student argues that teachers do not explain very well and has a not-easy-to-understand style.

3. RESEARCH RESULTS AND DISCUSSION

This section details the results of the inquiry based on COMEGAN-ro questionnaire and interview protocols. In addition, two case studies are presented based on the lessons that teachers delivered by using the pre-established lessons plans. The author made all the observations during the lessons delivery.

3.1. Distribution of metacognitive competence among teachers. The teachers participating in research reported their selves with medium to high levels of metacognitive competence (see Table 1 and Table 2). Significance tests conclude there is a statistically significant difference between the dimension of metacognitive knowledge and metacognitive regulation or management ($p < .01$).

Table 1 Initial level of metacognitive competence of teachers

Metacognitive competence and its components	
Metacognitive competence *Mean* = 3.55 *St. dev.* = .63 *Min* = 2.22 *Max* = 4.74	Metacognitive knowledge *Mean* = 3.54; *St. dev.1* = .65 *Min* = 2.01; *Max* = 4.75 Metacognitive management *Mean* = 3.47; *St. dev.1* = .78 *Min* = 2.15; *Max* = 4.79

Table 2 synthesizes values of statistical indicators computed for each of the six factors of metacognitive competence. Regulation has the lowest mean, with a statistically significant difference comparing to other factors.

Table 2 Statistical indicators of metacognitive factors in teachers

Factors of metacognition	*Mean*	*St. dev.*	*Min.*	*Max.*
Knowledge about persons	3.49	.72	1.86	5.00
Knowledge about strategies	3.60	.72	1.67	5.00
Knowledge about tasks	3.53	.86	1.33	5.00
Planning ability	3.54	.73	1.83	4.83
Monitoring and control	3.64	.75	1.63	5.00
Regulation	3.47	.78	1.00	5.00

A preliminary conclusion sustains that it is needed to develop adaptive metacognitive behaviors in order to improve teachers' capacity to deal with different types of issues in classroom. Qualitative data provided by interviews and lessons' observation indicates an interesting phenomenology of metacognitive behaviors in teachers. In order to describe these behaviors we will present the case studies.

3.2. Case study 1: blending digital educational content with traditional instruction. The first case study discusses metacognitive adapting behaviors of a geography teacher with 7 years of teaching experience. The lesson plan followed by the teacher was based on blending digital educational content with traditional instruction. The lesson started with a brief routine activity consisting of reviewing the previous lesson and presenting the topic of the new lesson. At one specific moment she tried to use the digital resources to sustain the period of practice. The teacher chose to use low interactivity learning objects instead of highly interactive ones. She played a cue-points movie and asked questions. When a student asked if they are allowed to go through another learning object, the teacher argued that object requires a lot of time and will solve it some other time. The lesson flowed to the moment of the assignment of homework.

This situation reveals that teaching may take place in non-routine contexts and teachers need to face them. In this specific context, certain metacognitive knowledge about the tasks oriented the teacher to adopt a *defense metacognitive behavior* by avoiding that task. Students disagreed with teacher's decision. In a very well-planned structure of the lesson, the integration of highly interactive digital content may result difficult. During the training phase

this teacher began the transition to an adaptive teacher based on focusing more on finding the problems, analyzing them and looking for solutions from different points of view.

3.2. Case study 2. Problem-based learning and collaborative work in classroom. This case study presents a non-routine context in which teacher is challenged to adopt different instructional strategies. This case focus on the experience of a biology teacher with 10 years of experience in teaching. He was invited to propose to his students a low-structured problem to be solved in a collaborative manner. The lesson flowed from a routine-based review of previous topics, presenting the new subject (the teacher gave a lecture and the students took notes). At the practice moment, the teacher presented the task (a low-structured problem) and invited the students to solve it without giving any other details or instructions. A moment of confusion followed then, because the students did not have enough intellectual and informational tools to solve the task. They did not have a planning phase and they started directly to argue on different points of view. Other students in the groups adopted a *lurker strategy* saying „is just a school task let's write something down to be done". In this time, the teacher was not involved actively in students' activity. When each group presented its solution, the students engaged in a debate over whose ideas were correct and the teacher had difficulties to manage the class and to assess the solutions.

In this context, the *provoking issue* for the teacher consisted of three different variables to be managed: his own behavior, students' behavior and the learning context. The teacher encountered difficulties in managing those variables. As he mentioned during the debriefing discussion, he did not thought that students will find difficult to work in groups to organize their selves. This teacher began to do off-line metacognitive work right after the lesson delivery by identifying issues in his behavior, in students' behavior and task-related issues. One solution proposed was to suggest to students to use their mobile phones to search for more information about the problem.

3.3. The phenomenology of metacognitive behaviors in teachers. This research study makes a contribution to the understanding of adaptive metacognitive behaviors in order to analyze the impact of their lack and to find ameliorative solutions. These case studies underline that teaching does not involve only routine activities but also *provoking issues.* These issues are built on different variables that are not in complete harmony. The main goal of the *Tools for thinking* training programme was to help teachers to find on-line solutions to solve provoking issues. In order to better understand teachers' needs, narrative data were analyzed. In this section, the author provides a description of teachers' metacognitive behaviors.

The most frequent behaviors focused on *metacognitive movement, metacognitive narrowing, and the bulldozer strategy.*

The first phenomenon we focus on is the *metacognitive narrowing*. From a behavioral point of view, *metacognitive narrowing* describes that teachers solve *provoking issues* by reducing the metacognitive spectrum usually to two factors: implementation and monitoring. More often, planning and regulation are suppressed. In addition, teachers encounter difficulties to integrate actively their knowledge on persons and tasks (see the case of the biology teacher).

Metacognitive movement appears as a consequence of the lack of metacognitive strategies needed to regulate teachers' own cognition and students' intellectual activity. In this case, the teachers will transfer their responsibility to plan, monitor or regulate a solving task process to the students as presented in the case of biology teacher. The results of applying such strategy are mostly negative in the way that teachers translate their responsibility to the students as the last available solution.

The *bulldozer strategy* is another metacognitive strategy, consisting in solving a task or a problem without paying enough attention to the request or monitoring the solving process. As a circular reaction, this strategy conducts to poor academic results and low appreciation of students' work. Both teachers presented in the case studies adopted the *bulldozer strategy* in the sense that they applied the lesson plans without asking any clarification questions even they had the occasion to address them. The teachers did not analyze carefully the tasks and suppressed the planning phase, a crucial moment when facing new situations.

In order to provide teachers with appropriate strategies to promote adaptive instruction the training programme focused on analyzing *provoking issues* and finding flexible solutions. During the intervention, the teachers had been involved in the process of making decisions and giving solutions for their own problems rather than observing other people and commenting.

After the training delivery, both the teachers from the control and treatment group were invited to solve *provoking issues* known form the pretest phase and new ones.

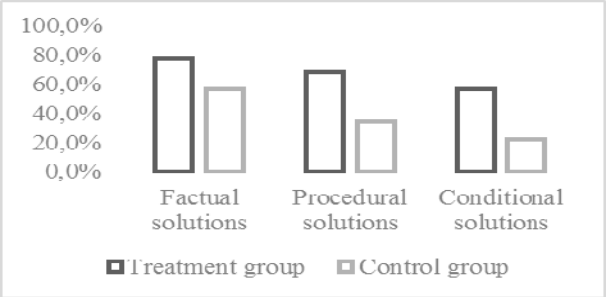
Qualitative and quantitative differences appeared in the posttest phase. Each group generated an equal number of solutions. Based on a coding matrix, the answers were coded into three categories: *factual* solutions, *procedural* solutions, and *conditional* solutions. For all the three types of solutions the participants in the training condition were able to generate a higher number of solutions the subjects in the control group. The results of the coding operation are presented in Fig. 1.

A factual solution was considered an answer saying that: „As far as I know, the teacher should ask the student why he/she thinks in that way (in relation to the nn-routine case of the student who disagrees with human rights). A factual solution designates an answer with no or low involvement of teacher in solving that provoking issue. These solutions have the lowest level of complexity.

The procedural solutions focused on action answers where teachers referred to their selves and provided a medium to high involvement solution: "I shall try to discuss with the student, trying to explain the importance of the human rights and to find good examples to support my point of view".

The conditional solutions are the most complex ones in the sense they link competing variables: group's opinions, teachers' opinions and instructional context: "I shall try to find out other students' opinions and if they agree with the student in discussion I shall animate a debate on this. If the group disagree with him, I shall ask them to bring examples and arguments".

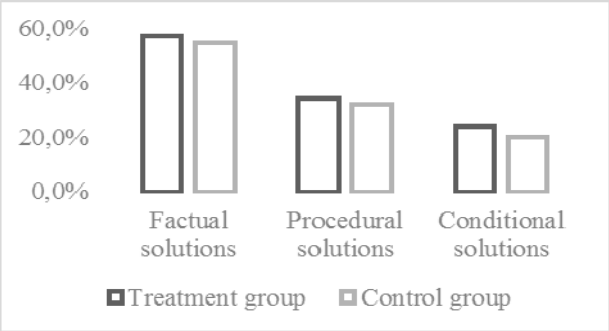
Fig. 1 Percentage of participants who were able to generate solutions for provoking issues in *posttest*



Significant differences can by identified by comparing the number of solutions provided in the pretest (see Fig. 2) and posttest phases. In the case of the treatment group the number of solutions increased quantitatively and qualitatively. A slight difference between pre-test and posttest can be noticed in the control group but we assume there is the effect of retesting the subjects.

The COMEGAN-ro questionnaire was not applied in the posttest phase. We consider that the training programme taking place during 80 hours is not enough to improve all the factors of the metacognitive construct. Thus it was preferred the qualitative approach.

Fig. 2 Percentage of participants who were able to generate solutions for provoking issues in *pretest*



3. A-HA APPROACH. TOOLS TO SCAFFOLD ADAPTIVE METACOGNITION

In this section we describe the *A-HA approach* designed to scaffold adaptive metacognition: provoking issues-based training. This approach is meant to support teachers to evaluate on-line and off-line routine and non-routine situations and to provide positive solutions to cope with those situations. The goal of this approach is to prepare teachers to respond to different situations that can appear in instructional contexts. Furthermore, we aim to provide them with appropriate strategies to analyze and differentiate from routine and non-routine situations. To support this approach we identified a number of frequent situations or recurrent problems in instructional sets (e.g. apathetic students, bad attitudes on school, low motivated students, and disturbing students).

The A-HA approach is based on erotetic techniques, namely asking the right questions in order to solve a specific situation. According to different types of questions, erotetic matrix were designed. The *Start matrix* aims to help subjects to decompose a specific situation in terms of known and needed to know information. The three main questions to ask are: *What do I know about this?, What I need to know about this?, What I would like to know about this?*. These questions drive the subject from a factual solution with low or no involvement to a high-involvement one based on stimulating teacher's curiosity about that situation. After the identification of needed information and variables, the participants provide solutions. These solutions are assessed based on another erotetic matrix described in Table 3.

Table 3 Erotetic matrix to scaffold regulation

	Before activity	During activity	After activity
What did I do right?			
What did I do wrong?			
What I will do again?			
What I won't repeat again?			

In addition, especially for low experienced teachers, an erotetic matrix for off-line evaluation was designed. Teachers are invited to use frequently this matrix in order to become more sensitive to routine situations and to identify the elements of novelty (see Table 4).

Table 4 Erotetic matrix to analyze routine and non-routine situations

	Answers
What did I do?	
Why did I do?	
Which was my reaction?	
What did I learn?	
Goal setting	

A very important element of this matrix is *goal setting*, challenging the subject to adopt prospective behaviors.

4. CONCLUSIONS

We conclude our article by summarizing the findings of the research study in relation to the importance of developing teachers' metacognitive competence. As argued in previous sections of the paper, there is a growing interest for metacognition research in sciences of education. Schools, students, parents, and teachers change. Classroom management strategies are not enough to offer appropriate solutions for specific instructional situations. Provoking situations and events may appear. In other words, *one size does not fit all.* Thus, teacher are challenged to offer solutions to increase the quality of instruction and to promote visible learning. To solve these situations teachers need complex metacognitive competences. The research revealed that teachers self-reported with medium to high levels of metacognition. Unlike the quantitative approach, qualitative data revealed a specific phenomenology of metacognitive behaviors affecting teachers' responses to non-routine situations. To discuss the first interrogation launched in this article, we say teachers are more likely to have routine metacognitive behaviors rather than versatile ones. In this case an ameliorative intervention is needed.

Furthermore, we proposed an approach designed to improve metacognitive capabilities of teachers, namely the A-HA approach, based on erotetic techniques. In relation to this training programme, the second interrogation focused on the impact of the A-HA approach.

Posttest data proved there are significant differences between the two moments of testing. The teachers in the treatment group were able to propose a higher number of solutions to solve provoking issues.

Our intent is that the A-HA approach will help to set up further research in the metacognition field and help teachers to significantly increase their metacognitive capabilities.

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