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DIFFERENTIATED INSTRUCTION: INTERACTIVE METHODS WITH MATHEMATICS AND ENGLISH LANGUAGE TEACHING METHODOLOGY SEMINARS. A COMPARATIVE ANALYSIS

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Abstract: The aim of the present paper is to further research into the concept of differentiated teaching, an idea as old as effective teaching, and to indicate its utility within Mathematics and English Language Teaching Methodology seminars focusing, this time, on interactive methods. Being double motivated to experiment with this approach, as content teachers and methodologists at the same time, the authors considered their first-hand experience worth including in a paper and imparting it with peers, under the format of a comparative analysiss, after detailing on the resourceful strategies used and their outcomes, as well as after referring to updated specialised literature in the field.

Key words: differentiated instruction, interactive methods, comparative framework.

1. Introduction

Starting from what Tomlinson expressed as her credo that "developing academically responsive classrooms is important for a country built on the twin values of equity and excellence" (1999, p. 12) and getting into more depth with what the same author developed in order to help teachers under enormous pressure achieve performance in today's classroom automatically defined as "more diverse, more inclusive, and more plugged into technology than ever before" (Tomlinson, 2014), the present paper comes as a result of the extended interest manifested by the authors in the concept of differentiated instruction and its modern approach. At the same time, it is a sequel to the paper based on analysing the didactic game and individual work as two possible modalities to address the idea of teaching in a differentiated manner with the Mathematics and English Language Teaching Methodology seminars, being interested in dwelling on the most significant interactive methods and means to implement differentiation in class. Its aim is to address learning and affective needs that all students have and to teach up considering a student-focused way of thinking about teaching and learning, thus placing the approach at the

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core of quality teaching. Striking as absolutely necessary for success with attaining the standards for a broad range of learners, according to the Infographic (2015) displayed on the front page of ASCD75 Supporting Educators Yesterday, Today, and Tomorrow site, differentiated teaching involves planning in advance for diversity, in heterogeneous settings, designing around patterns of student needs, using flexible and creative grouping purposefully projected and considering not only the content, but also, as Tomlinson (2000) theorised, the process, products and learning environments. Consequently, what the students have to learn and the way in which they will have access to the information should not be the only aspect taken into account with differentiation, but also "the activities in which the student engages in order to make sense of or master the content, the culminating projects that ask the student to rehearse, apply, and extend what he or she has learned in a unit, and the way the classroom works and feels" (Tomlinson, 2000, p. 3). Differentiation is not discriminating among students by either grouping them into classes according to their special needs as a result of somehow being incompatible with the standards, thus teaching down to them, or by selecting them as 'gifted' or 'special' and challenging the curriculum to the maximum by means of assigning extra learning challenges to them as something extra, on top of good teaching (Infographic, www.ascg.org, 2015). Differentiated instruction is not synonym to only individualised work or group work, hence the desire of the authors of the present paper to further research into this concept and not simply adhere to a one-sided approach to it (Nechifor, Purcaru, 2017), "but rather an approach to instruction that incorporates a variety of strategies" allowing "all students to access the same classroom curriculum by providing entry points, learning tasks, and outcomes that are tailored to students' needs" (Hall, Vue, Strangman, & Meyer, 2003). Subsequently, "in a differentiated classroom, teachers divide their time, resources, and efforts to effectively teach students who have various backgrounds, readiness and skill levels, and interests." (www.ascg.org, 2017).

Silver, Jackson and Moirao's concept of "task rotation is a strategy that provides teachers with a manageable and highly effective way to differentiate learning activities, questions, and assessments via learning styles" (2011, p. 1) by presenting the students with "four interrelated tasks that ask them to use different styles of thinking: mastery tasks, asking the students to remember and describe; understanding tasks, asking the students to imagine and create and interpersonal tasks, asking the students to explore feelings and relate personally" (2011, p. 10).

Dwelling on Sternberg's idea that "when teachers incorporate a variety of styles of instruction into classroom activities, their students routinely perform better on objective tests and performance assessments than do students who receive *traditional* instruction" (2006, p. 30) and also considering to "integrate the habits of mind, a set of dispositions that increase students' capacity for skilful thinking" (Costa, Kallick, 2008, 2009), we pursued with applying differentiated instruction in our seminars in order to better understand our students and their learning difficulties so that their individual needs be catered for and met in order for them to be able to achieve personalised learning performance.

2. Means of using Interactive Methods as Strategies of Differentiated Instruction

Using interactive differentiated methods with the Mathematics and English Language

Teaching Methodology seminars proved its utility as it removed some of the issues our students used to have when approaching problem solving in either of the two subjects. Thus, in what is to come, we will describe what exact strategies we used, how we adapted them to the age and content knowledge level of our students and how they proved useful for them, relative to their interest, creativity, originality, flexibility, fluidity and thinking, irrespective of their methodological background.

Mention needs to be made that he tasks created and used for each method address, from a psychological point of view, the age particularities and the cognitive structure of the elementary and gymnasium profiles of pupils, as they are the candidates to learning that our students enrolled for the pedagogical module that we worked with for the present analysis will teach after graduating the bachelor level of their university education.

Moreover, after comparatively describing the possible drills that can be applied in a differentiated manner to both Mathematics and English Teaching Methodology seminars, we will try to establish the potencies and limits of each method, in order to be able to evaluate the gains, advantages and benefits obtained as a result of using them.

2.1. The Cube Method

Variants of using this method in a differentiated manner are as follows:

According to a first variant, for each surface of the cube, the teacher will design two task cards having different levels of difficulty. The students will be divided into two homogeneous groups, according to the relative level of knowledge they already have at the moment of implementing the method, as a result of the placement test they undertook at the beginning of the instruction cycle, which will be the case for each division into groups and for each method described below. Thus, the teacher will hand in to the students a card containing the number of the group they belong to and to each group the Cube method will be applied.

Considering a second possible variant, the cards corresponding to each surface can have items of progressive difficulty, so that each student should be able to bring his or her contribution to solving them, depending on the individual level of knowledge. With this variant, students work differentiated within each heterogeneous group.

Regarding a third variant, the cards can be projected to contain increasing levels of difficulty for the tasks, in this way: for the first two verbs, the items can be of low difficulty, for the next two, of medium difficulty, while for the last two, of high difficulty. The students will be divided into three homogeneous groups and the teacher will assign to each member of the groups items according to their level of knowledge.

As an observation, this method can be used when there are more theoretical issues submitted to the process of drilling and assessing, but, depending on the real learning environment in class, other variants of this interactive method can be applied, as well.

In what a possible exam review situation is concerned, examples can look like this, for the first variant mentioned above: the first card, called 'Describe', for the low level of difficulty, requires the Maths students to describe the methodology of teaching-learning addition and deduction of natural numbers from zero to ten, while the English students can ask them to describe the methodology of teaching Present Simple and Present continuous, according to their basic structures. For a medium level, the card can ask both the Maths and the English students to describe the methodology of organising and implementing the mathematical didactic game. The second card, called 'Compare', starts from a medium level of difficulty and encourages Maths students to compare the lesson development of teaching measurement units for length to those for mass, while the English students can be asked to compare the lesson development of teaching vocabulary associated to greetings to that of teaching vocabulary associated to travelling. In what the high level is concerned, the Maths students can be asked for a comparison between 'the red-thread' of teaching measurement units for time and those for value, while the English students can be faced with comparing the unfolding of a vocabulary class focused on food and dishes to one focused on body parts, with all its internal and external components. The third card, called 'Associate', addresses, again, the medium level asking the Maths students to associate to each learnt item from the unit dealing with measurement units, grade 4, an example, and the English students to associate to each type of food appropriate dishes and courses within a menu. The high level can have the same requirement, but for the unit dealing with writing numbers in Roman figures, still from the 4th grade, for the Maths students, while the English students can be asked to imagine a doctor-patient encounter in order to activate the vocabulary related to body parts in the context of pains, aches and sores. The next card, called 'Analyse', for the medium level can elicit from the Maths students an analysis of the types of mental calculations learnt and to indicate which if they can be applied efficiently with the seminars in which differentiated instruction is used, while the English students can dwell on the types of contexts in which Present Perfect is used and whether they can be subjected to a differentiated type of instruction in class depending on the relative language levels the pupils may have. The high level, the rubric can be the same but focused on the types of problem composition instead of mental calculations, with the Maths students, while the English students can focus on the possible differentiated approach in class when teaching the difference between Present Perfect and Past Simple. The fifth card, called 'Argument', for a low level, the activity can consist in asking the students in both Mathematics and English to support the statement: 'While teaching and learning Mathematics/English in the context of simultaneous work, some specific problems occur', while for the medium level, the task environment can refer to: 'There are several ways of cultivating students' creativity within Mathematics/English classes.' The last card, called 'Apply', for the low level, can ask the Maths students to 'Apply the "redthread" for teaching natural numbers to teaching figure 7', whereas for a medium level the students can be asked to 'Apply the "red-thread" of teaching geometry elements to teach the concept of a rectangular'. For the same verb, for the low level, the English students can be required to 'Apply the logical development of a teaching vocabulary class to teaching greetings', while for the medium level to 'Apply the steps of teaching grammar tenses to teaching Past Tense'.

To exemplify for the third variant mentioned in the paragraph before the last one, the cards corresponding to the verbs 'describe' and 'apply' containing the low-level items can be selected from the previous example, as well as the cards containing the verbs 'argument' and 'associate' with items of a medium level and the 'compare' and 'analyse' cards containing the high-level items.

2.2. The RAI (Round Associated Ideas) Method

Two variants of using this method, first of all described as strategy and then exemplified, are as follows: one of them takes into account dividing the students into two

homogeneous groups to which the RAI method will be applied. As part of this division, within each group, questions will be asked according to the difficulty level corresponding to all team-mates from that group. The other variant considers working with one whole group, but each student is asked to bring to the front desk the note containing the question formulated individually. Thus, when a student throws the ball at another student, the teacher will choose for the student who is supposed to answer a question appropriate to his or her level. As a result of applying either of the two variants, two or three sets of questions of diversified difficulty will be obtained and, according to the needs of the class environment, other combinations of this method can be envisioned and implemented.

The RAI method can be applied with different goals in mind: either for assessing students' knowledge, followed by an improvement stage, or for building skills and abilities, as proven by an example from both the Mathematics and English Teaching Methodology seminars, designed for the second variant described above, and containing samples of questions formulated by students. Thus, in what the low level is concerned, these following questions are to be considered: 'What is the aim of the Mathematics/English Teaching Methodology class?' 'What criteria should an "ideal" Mathematics/English manual meet?', 'What is and what can an assessment matrix be used for?', 'What are some teaching-learning methods used daily in simultaneous instruction?', 'Compose a problem that can be solved by means of addition and deduction' - for Mathematics, or 'Imagine a context in which both Present Simple and Present Continuous can be used' - for English.' Regarding the medium level, the questions sounded like this: 'What modalities of cultivating pupils' creativity with a Mathematics/English class do you know?' 'What are the three stages that should be followed to form the notion of addition? - for Mathematics' or 'What are the two possible temporal values that Present Simple can express in different contexts? - for English', 'Compose a problem that can be solved by means of addition, deduction and division for Mathematics' or 'Suggest a real life context in which you need to use all types of past tenses you know - for English', 'What difference is there between mental and oral calculation? - for Mathematics', or 'What difference in there between reading a text silently and reading it aloud? - for English', 'What types of assessment items do you know? Exemplify'. Referring to the high-level questions, here are some samples, firs of all for Mathematics and then for English, in this order: 'What formative nuances can be traced in the solving activity as different from the mathematical didactic game?', 'Compose a problem that can be solved by means of addition, deduction and division, in this order, and another one that can be solved using the reverse order of the three.', 'What analogies can you find between the methodology of teaching and learning measures and measurement units for measures?', 'Compose a problem based on the formula: a x (b + c), then modify it so that its literal formula correspond to the one obtained by applying the property of distributivity of multiplication relative to addition in the formula above.', write a story in the first person singular then modify its perspective to third person singular. Make all necessary adjustments from a grammatical, stylistic, vocabulary and discourse point of view', 'Report someone's discourse in two possible ways, first using the dicendi verbs in the present and then using the dicendi verbs in the past, for the second situation applying all necessary rules of sequence of tenses and reported speech required.', 'Build on the temporal values that Present Simple and Present Continuous can take, as different from the basic grammatical information they embody in their own basic formula, by adding adverbials of time with a different reference and by including them in contexts that elicit other time specification from them.', 'What resemblances and what differences can be found between the mathematical and English didactic game?'

2.3. The Jigsaw Method

For this method, too, we suggest at least two possible variants, which, in their turn, as mentioned with each and every method described so far, other combinations or digressions can occur, depending on the necessities in real learning environments.

The first way refers to the fact that each subtopic corresponding to the main card could be designed to have different levels of difficulty, while the second way aims at having the rubrics associated to the subtopics on different levels of difficulty, while the subtopics themselves can remain at the same level. In this way, irrespective of the variant applied, each student can bring his or her own contribution to solving the tasks.

The Jigsaw method can be used both during classes, to teach new content by relying on students' involvement, and with the seminars, to develop skills and abilities.

For the first modality of implementation, an example from a Mathematics Teaching Methodology seminar focused on particular methods of solving arithmetical problems unfolds as follows: the teacher divides the group into four homogeneous subgroups, a criterion being, this time, as different from the one mentioned at the beginning of the paper, the type of subject solved by each student at Mathematics in the Baccalaureate exam: M1, M2, M3, etc. The subtopics may sound like this: 'The comparison method. Present it and exemplify it.' (low-level subject in the BAC exam, dedicated to the humanities profile); 'The method of false hypothesis. Present it and exemplify it.' (medium-level in the BAC exam, dedicated to the social sciences profile); 'The reversed reasoning method. Present it and exemplify it.' (high-level in the BAC exam, dedicated to the sciences profile); 'The figurative method. Present it and exemplify it by means of an atypical problem.' (very high-level in the BAC exam, dedicated to the Mathematics-Computer Science profile). For the English counterpart, the division criterion can target the international language descriptors used to establish the level of knowledge in a certain language, also used at the BAC exam when assessing the four language skills, according to the A1, A2, B1, B2, C1, C2 levels. Consequently, depending on the markers assigned to the students on the occasion of the BAC evaluation language test, they can be divided into 4 subgroups, as follows: B1, B2, C1, C2, as the A1, A2 levels, corresponding to the beginner and elementary, are not considered for this exam. Thus, for the B1 level, the students can be asked to 'Write a story in the past referring to a terrifying experience you went through', for the B2 level 'Write a short-story about a fictional character that may live on another planet', for C1 level 'Present a solid argument for or against capital punishment' and for C2 level 'Starting from a real life situation, weighing both the advantages and disadvantages, state your opinion about lifelong learning, using examples and a variety of lexical resources.'

2.4. The Brainstorming Method

A two-fold approach to this method made the interest of the authors when working with interactive methods in a differentiated manner. Thus, students can be distributed either in two or three homogeneous groups, depending on their level of knowledge in Mathematics and assigning tasks relative to their levels, corresponding to the level of the group they

belong to, or in heterogeneous groups with a single task, but designed in a progressive manner, so that each student can contribute something to the process of solving it. These Brainstorming variants can be used both at the beginning of a class or a seminar to activate knowledge taught before and towards the end of a class to obtain feedback and attain performance.

Considering the first variant, for a Mathematics seminar that focuses on the order of solving the operations, the students can be divided into three subgroups and to each group a variant of the Brainstorming method can be applied depending on the level of students' knowledge in Mathematics Methodology. Subsequently, for the low-level, the task can be phrased like this: 'Compose as many problems as possible starting from the following numerical formulae a) $30000 - 1500 - 500 \times 12$; b) $30000 - 1500 - 500 \times 12$: 4'. For the medium-level: 'Compose as many problems as possible starting from the following numerical formulae a) $(30000 - 1500) - 500 \times 12$: 4 + 200; b) $(30000 - 1500) - 500 \times (12: 4) + 200$.' And for the high-level: 'Compose as many problems as possible starting from the following the following numerical formulae a) $[30000 - (1500 - 500 \times 12)]$: 4 - 30 x 400 + 2000; b) $[(30000 - 1500) - 500) \times 12]$: 4 - 30 x 400 + 2000.'

For the English Methodology seminar, students can be faced with the following requirements: for the low level group, 'Retrieve from your memory and from your previous knowledge, as many words associated to the semantic field of fruit and vegetables as possible", for the medium-level, 'Come up with as many vocabulary items associated to the field of agriculture of and organise them on columns according to their type: fruit, vegetables, instruments, vehicles, activities', while for the high level the task can be developed into 'Organise semantic charts related to the field of agriculture, attributing to each vocabulary item a possible collocation, cognate object, idiom that you can activate, according to your previous knowledge.'

The same tasks can be used for the second variant of the Brainstorming method, but the scheme of distribution of the cards is differentiated according to the level of knowledge of the students in the heterogeneous group.

2.5. The Starbursting Method

A variant of using this method in a differentiated manner could be as follows: the students will be grouped according to their level of knowledge in Mathematics and to each group the Starbursting method will be applied depending on the level of the students belonging to each group. For a seminar based, on the one hand, on the methodology of teaching addition and deduction of the natural numbers, with the medium-level group, and, on the other hand, on the methodology of teaching multiplication and division, with the high-level group, the questions formulated by the students were of this type, for each group:

'Which are the steps in forming the notion of addition? Where, in the process of forming mathematical notions, have you used amounts of concrete objects? What are the steps in forming the notion of deduction? What resemblances are there between the methodologies of teaching these two operations? Why do we say that the same theory regarding the teaching of addition and deduction with numbers from the zero to ten range stays the same with numbers from the zero to twenty range? Who has noticed the existence of specific methodological problems regarding the two operations with numbers from a new range?', for the medium-level.

'What procedures to establish the result of multiplication are there? What procedures regarding oral multiplication and division do you know? Who can specify how multiplication can be carried out in writing? How about division in writing? What procedures to establish the result of division do you know? Where do you use oral multiplication and division? What are the main steps to follow to teach multiplication by a natural number of one figure?', for the high-level.

In what English is concerned, for a seminar based, on the one hand, on the methodology of teaching receptive skills (reading and listening), with the medium-level group, and, on the other hand, on the methodology of teaching productive skills (writing and speaking), with the high-level group, the questions formulated by the students were as follows, for each group:

'What is meant by "receptive" and what types of language abilities should a learner develop to score high in reading and listening?', 'How many types of comprehension exercises can be created for receptive skills and what are they meant to check?', 'What are the compulsory stages that each drill based on either listening or reading should contain?', 'What are the mistakes that can occur when stating that the type of the lesson to be taught is either listening or reading, or even a combination of the two skills, but there are no specific tasks focused on them?', 'What is the marking scheme and how can the descriptors for the receptive skills be phrased?', for the medium-level group.

'What is meant by "productive" and what types of language abilities should a learner develop to score high in writing and speaking?', 'How many types of tasks and task environments can be imagined for the productive language skills, from the point of view of free versus guided?', 'What are the compulsory steps to be followed when dealing with a task in writing or speaking?', 'What are the mistakes that can occur when stating that the type of the lesson to be taught is either of a writing or of a speaking type, or even a combination of the two skills, but there are no specific tasks focused on them?' 'How is marking perceived for the productive skills from the point of view of subjectivity versus objectivity and how can this issue be reduced to a minimum of doubt?', for the high-level group.

2.6. The Share-Pair Circles Method

Some variants to use this method refer to either forming two concentric circles relative to two knowledge levels of the students, the exterior circle consisting of students with a high and medium level of knowledge, while the inner one of students with a low-level of knowledge, so that the students belonging to both circles will collaborate to solve the items included by the teacher on the card, or to dividing the students into two groups, depending on their knowledge levels, the students from each group receiving the card appropriate to their level of knowledge. Obviously enough, teachers working with the first variant of the Share-pair circles method will prepare only one card containing tasks of different levels of difficulty, while the ones adopting the second variant will have to design two different cards, appropriate to the two levels of knowledge of the groups.

For a Mathematics seminar dealing with the topic of solving problems, with the target of obtaining performance, for the high-level group the tasks can be formulated like this: 'Compose a problem that can be solved by using four operations and a parenthesis.' or 'Compose a problem having four tasks.' or 'Compose a problem that can be solved by using three operations and a parenthesis. What other variants can you obtain?' or 'Compose a problem that needs to be solved by using an addition, two multiplications and two divisions in this order.' or 'Compose a problem that accepts two solving methods.' or 'Compose a problem with incomplete data and one with supplementary data.' or 'Compose a problem that must be solved by means of using the reverse reasoning method.'

For an English seminar focused on the topic of essay writing, with the same target settled, that of obtaining performance, still for the high-level group, the tasks could be phrased like this: 'Design a task environment for an essay which should balance two point of view starting from a statement and then ask the students to pass their own opinion.' or 'Write a task environment for an argumentative essay eliciting the students' opinion from the very beginning and ask them to support it with at least two arguments and provide one counter-argument.' or 'Imagine a task environment for an essay that asks the students to provide reasons which led to and solutions to solve a certain situation.' or 'Create a task environment for an essay that can be written according to all three possible guided structures: personal opinion supported by arguments, balancing two points of view and afterwards stating the personal opinion, finding reasons and solutions to the same situation.'

For the medium to the low-level of knowledge group, the tasks in Mathematics can sound like this: 'Compose a problem that can be solved by using three operations.' or 'Compose a problem that needs to be solved by using an addition, a multiplication and a division.' or 'Compose a problem having two tasks.' or 'Compose a problem using numbers 3, 36, 5.' or 'Compose a problem with a given beginning.' or 'Compose a problem using some realia' or 'Compose a problem according to the following scheme: Geese______, Ducks ______, in total 115 birds.'

In what the English tasks are concerned for the medium and low-level group, they can be formulated as follows: 'Create a context for writing a story focused on a past situation.' or 'Write a task environment for a future projection of a personal plan, asking the students to write a short story about their intentions for next year.' or 'Compose a task for a written assignment dealing with a present recurrent problem that bothers the students and ask them to come up with solutions to it''.

3. Conclusions

Considering the above data collected as a result of our first-hand experience in class, working with the students aspiring to become teachers and offering them the possibility not only to evaluate their content related knowledge in the specialised fields they are still currently studying for majoring in either Mathematics or English, but also to activate their metalanguage and to raise their methodological awareness, we came to the conclusion that differentiated instruction, applied by means of the interactive methods analysed above, proves its value and usefulness irrespective of the field of the subject matter taught and level as it generates appropriate leaning environments for each students, activates individual skills that can lead to performance on a personal level against internal criteria and eliminates frustration, decreasing the potential of dropouts as a result of poor learning results.

The fact that differentiated instruction has always been on the drawing board of professionals in the field of teaching methodology is very well known. The fact that it has become fashionable again, as a result of the liberal entrance system adopted for some time in Romania by universities nation-wide is a reality and its usefulness has been proven by the present research paper (papers) once again. What has remained a challenge yet and needs to be addressed, strictly related to the concept of differentiated instruction is differentiated assessment, which the authors of this paper intend to tackle in a further research, starting from Wormeli's latest analysis (2005) covering the touchy grading practices in differentiated classrooms, from 'whether to incorporate effort, attendance, and behavior into academic grades, grade homework, set up grade books and report cards to reflect differentiated practices, allow students to re-do assessments for full credit to how to create useful and fair test questions.'

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