R E V I E W

in relation with a procedure of awarding the educational and scientific degree „doctor"
in the Field of higher education 1. Pedagogical sciences
Professional field 1.2. Pedagogy (Special education)
Doctoral program "Special education in English"
topic „Application of the differentiated approach to the mainstream mathematical learning of students with dyscalculia",
author Afroditi Lampros Kosma,
full-time PhD student in the Faculty of Educational Studies and the Arts, Sofia University "St. Kliment Ohridski"

1. General presentation of the procedure

The present review is prepared from the position of a member of the scientific jury included in the Register of Sofia University "St. Kliment Ohridski" under No 62/19.10.2023 and legalized with Order No РД 38-591/21.10.2023 of the Rector of Sofia University "St. Kliment Ohridski" – Prof. Dr. Habil Anastas Gerdjikov, in compliance with Art. 4 from The Law for the Development of the Academic Staff in the Republic of Bulgaria (ЗРАСРБ), Art. 2 para (8) of the Regulations for applying ЗРАСРБ, Art. 5 para (12) from The Regulations on the Terms and Conditions for Acquiring Scientific Degrees and Occupying Academic Positions in Sofia University "St. Kliment Ohridski" and on the basis of a corresponding Decision from 17.10.2023 (Protocol No 13) of the Faculty Council of the Faculty of Educational Studies and the Arts (FESA) in relation with a procedure of awarding the educational and scientific degree „doctor" in the Field of higher education 1. Pedagogical sciences, Professional field 1.2. Pedagogy (Special education), Doctoral program "Special education in English", topic „Application of the differentiated approach to the mainstream mathematical learning of students with dyscalculia", author Afroditi Lampros Kosma, full-time PhD student in FESA, scientific advisor Assoc. Prof. PhD Anna Konstantinova Trosheva-Asenova.

No procedure irregularities were identified. Let me mention that the topic of the PhD dissertation is announced as „Application of the differentiated approach to the mainstream mathematical learning of students with dyscalculia". It is different from the topic announced in Protocol No 1, dated November 2, 2023, from the first meeting of the scientific jury, namely „A model of differentiated education in Greek language and literarture of students with dyslexia in secondary schools", as well as in a previous variant of the protocol „Deficit of attention and hyperactivity – their reflection on lerning capability under dyslexia of the development". I accept the topic of the PhD disserttion and the corresponding summary to be credible..

2. General presentation of the candidate

The documents of the candidate in connection with the procedure enable an objective and complete evaluation in accordance with the requirements of the National Acts (ЗРАСРБ and the Regulations for its implementation), as well as the Regulations of SU "St. Kliment Ohridski" and FESA.

Afroditi Kosma is with Greek nationality, born on 19th September 1975 in Joaninna. In the period 1994-1999 she followed Bachelor in Mathematics, School of Science, Department of Mathematics, University of Ioannina, while in the period 1999-2000 – Master of Science in Business Economics and Policy, Department of Economics, University of Surrey, UK. In 2014-2016 Afroditi Kosma studied Master in Business Administration, University of Nicosia, Cyprus and finished with Overall Award Average (CPA) 3.675 (out of 4.0). In the period 2017-2019 she studied Med in Special Education, University of Nicosia (joint degree with the University of Patras, Greece). In 2019 Afroditi Kosma was enrolled in Sofia University "St. Kliment Ohridski" as PhD candidate.

The professional career of Afroditi Kosma started in 2000. In the period September 2000 – June 2001 she has taught Accounting in the Vocational Training Institute, School of Management and Economics. In the period 2000 – 2006 Afroditi Kosma was Research fellow in Technological Educational Institute of Epirus (TEI), Faculty of Management and Economics, Department of Accounting and Finance, teaching Business Policy and Strategy, Applications of Quantitative Methods in Economics, Mathematics for Economists and Introduction to Insurance Science. In 2006 she has taught Sales techniques and Business Administration and Organization in the Vocational Training Center NEO THETIKO, Preveza, Greece. In the same center Afroditi Kosma has taught Business Statistics in the period November 2006 – April 2007. Later in the period December 2007 – March 2008 she has taught Sales management in the Vocational Training Center EREUNA, Arta, Greece. Afroditi Kosma was a teacher of Mathematics in the Second Chance School of Arta, Ministry of Education, Greece in the period February 2010 – July 2010; teacher of Mathematics in Special Education in the High School, Ministry of Education, Greece in the period October 2017 – June 2020. Presently, since September 2020 Afroditi Kosma is a teacher of Mathematics (in Mainstream Class), Secondary Education, Ministry of Education, Greece. The PhD candidate had a lot of other working activities: Business Loans consultant in EFG Eurobank SA, Branch of Preveza in the period May 2001 – August 2007; Assistance manager in Millenium Bank SA, Branch of Arta in the period August 2007 – May 2011; Branch manager in Geniki Bank AE, Branch of Preveza in the period October 2011 – November 2014 and Assistance manager in Pireaus Bank, Branch of Arta in the period November 2014 – December 2016.

3. Topicality of the issue in the dissertation

It should be noted that dyscalculia is an upset in learning calculating skills by children with a normal intelligence (it appears among adults too). It is manifested in incapability to solve elementary mdthematical problems. The deficit concerns the execution of basic arithmetic performances – addition, subtraction, multiplication and division. The number of the affected persons with dyscalculia increases more and more. Students with dyscalculia show decreased cognitive skills and the interest to study falls in many cases. An important task for their educators is to characterize the obstacles and to provide conditions for interest increase. It is possible that dyscalculia appears simultaneously with dyslexia and dysgraphia or with other disorders of the central neuro system. Although dyslexia affects reading and writing mainly while dyscalculia refers to the mathematical domain concretely, further investigations are necessary to discover the complex relation among difficulties, intelligence and arithmetic achievements. The goal of the doctoral dissertation is to assess the effectiveness of the

corrective differentiating teaching of students with dyscalculia in mass mathematical classes. The main task is to compare students with or without disorders in mathematics learning and also to identify psychological and neuropsychological differences in the study of mathematical performance, individual and family characteristics. The PhD dissertation includes designing, implementation and evaluation of the curriculum in the frames of the mathematical curriculum in order to increase mathematical understanding by students with learning difficulties. The considered issue and the corresponding conclusions make the dissertation topical and significant.

4. Structure and content of the dissertation

The dissertation is presented in English and consists of 268 pages. It contains 5 chapters united in 2 parts – "Theoretical background" (chapters 1 – 3) and "Research approach" (chapters 4 – 5). Conclusions and suggestions are included too. The bibliography is rich. It consists of publications in English on 13 pages without enumerations of the titles. A catalogue with 69 tables and a catalogue with 6 graphs are proposed. An important part is the annex listing mathematical criteria for grading, mathematical ability criterion (pre-test), mathematical skills criterion (post-test), mathematical ability criterion (final test), teacher and parent questionnaires, profession based categorization.

Well-known investigations of mathematical difficulties and arithmetic deficit by other authors are discussed in Chapter 1 „Dyscalculia". The chapter has an important preparatory significance and deserves high praise. A detailed review of the existing publications on the topic is realized. What is underlined is the important influence of Neuropsychology in understanding the main mechanisms of educational disorders. Various types of dyscalcula are identified. Of interest is the relationship between brain function and human behavior. Numerical computation disorders are associated with focal brain lesions. Different paragraphs are dedicated to: developmental dyscalculia and dyslexia, mathematical difficulties of children with dyslexia, various research approaches to developmental dyscalculia, review of neuropsychological research on acquired mathematical disorders, neuropsychological classification of acquired disorders of mathematical operations. A cognitive neuropsychological model is discussed for interpreting disorders of mathematical abilities and a neuropsychological classification of learning disabilities is proposed. No doubt, the corresponding tables in the dissertation are useful and they will help other researchers successfully. What are discussed additionally are hemispheric differences in brain function and children's performance in Mathematics. Functions controlled by the two cerebral hemispheres are presented in a special table. Some of the paragraphs consider cognitive and neuropsychological factors for the disorders, also how disorders of basic neuropsychological and cognitive functions affect learning of Mathematics. Various disorders are listed for the purpose.

The education of students with dyscalculia is governed by a series of regulatory documents that ensure equal access to education and support. They are considered in the beginning of Chapter 2 "Education of children with dyscalcilia". The terminology used in the topic of the dissertation is discussed in one of the paragraphs. Namely, the author clarifies that the differentiated approach to education is a teaching methodology that takes into account the diverse learning needs and abilities of students. Also, it is clarified that one of the key elements

of the differentiated approach for students with dyscalculia is the use of evidence-based instructional strategies. The author of the dissertation examines the differences of the differentiated approach in Bulgaria and Greece.

Chapter 3 "The analytical programs and teaching/learning of basic mathematical concepts and procedures" is dedicated to the clarification of mathematical knowledge understanding, also of declarative mathematical concepts teaching and teaching of procedural knowledge – mathematical processes and skills, including fundamental mathematical concepts and skills like the concept of a number and the concept of the place value of digits. The author deals with the evolution of the procedures for performing and memorizing simple arithmetic operations. Of importance is problem solving, i.e. the application of what was taught to the solution of problems. Some of the paragraphs in the chapter treat the categorization of problems of additive and multiplicative structures. Four different types of multiplication structures are distinguished: the isomorphism of measures, multiplicative factor or a space of measures, the product of measures or Cartesian product and the multiple ratio. It should be underlined the conclusion, that in case of a difficulty in solving problems by students with dyscalculia, emphasis must be placed on: the ability to understand the relationships between the data of the problem and the organization of a sequence of actions to find the answer. The main conclusion is connected with the necessity to strengthen student' s self-esteem, which can be achieved by initially setting small and easy goals. Of course, the teacher has to know what the student will be able to achieve them.

Chapter 4 "Research methodology" explains the purpose and the sub-objectives that follow from the selection method and the characteristics of the sample, the instruments, the time-table and the stages of the research. The method of the statistical analysis of the results is included too. The general goal is to investigate the effectiveness of the differentiated instruction of students with dyscalculia in the mainstream mathematical classes. Two sub-goals are formulated. The first one is the comparison of a group of students with learning difficulties in Mathematics with a corresponding group of students without difficulties.

Answers to several research questions are given connected with 3 hypotheses: Differentiated instruction will lead to significant improvement in mathematical abilities of students with dyscalculia when compared with a control group receiving standard instruction; students with dyscalculia will exhibit distinct differences in psychological and neuro-psychological development profiles compared with their classmates without mathematical learning difficulties; the individual and family characteristics of students with dyscalculia will be significantly different from those of their classmates without mathematical learning difficulties. The hypotheses are experimentally checked using sampling in 22 selected multi-seat schools in the region of Thessaly. Pupils from 4rd grade are sampled, including 69 with learning difficulties and 30 with a normal performance. The distribution by school is presented in a table which enables its perception.

The Athena Test for the diagnosis of learning difficulties is used. A questionnaire of individual developmental data and family and social data of the student is applied to fulfill the necessary condition for a valid diagnosis and a complete evaluation of students with learning difficulties. Also, a student performance evaluation sheet is introduced. The corresponding tools include a mathematical skills criterion, which is justified in details. The statistical analysis of the empirical data was performed with the statistical package SPSS. To test the relationship

between quantitative variables and to measure the intensity of this relationship, Pearson's linear correlation coefficient was calculated. It should be mentioned that the preparation of the statistical analysis and analysis itself are performed at high level which is one of the main achievements of the dissertation.

I will discuss the content of Paragraph 4.6. "Experimental teaching". It contains the curriculum of a mathematical course and is of crucial significance for the whole dissertation. Following its objectives which are justified well, the author has developed several lessons: Introductory lesson 1 (teaching of simple addition operations and subtraction - mental calculations); Lesson two (teaching simple operations of multiplication and division); Lesson three (position value of the digits); Lesson four (layout and comparison of numbers); Lesson five (reading and writing multi-digit numbers); Lesson six (the act of addition); Lesson seven (the act of subtraction); Lesson eight (addition and subtraction problems); Lesson nine (the act of multiplication); Lesson ten (the act of division); Lesson eleven (multiplication and division problems). All the lessons are accompanied with justifications and critiques of teaching.

Chapter 5 "Results" contains all the results of the investigations which are described in the previous chapters, including the results of the statistical analysis. The sequence of results presentation is the following: comparison of the performance of the two groups using the assessment criterion of the mathematical abilities (pre-test); comparison of the school performance of the two groups, based on the evaluation by their teachers; comparison of the performance of the two groups according to the Wechsler intelligence scales; comparison of the performance of the two groups using the Athena test for the diagnosis of learning difficulties; correlation of the three IQs with the mental capacity scales of the Athena test; family characteristics of the students from the two groups; comparison of the demographic characteristics of the families of the two groups; comparison of the students from the two groups according to the perceptions and attitudes of their parents towards Mathematics; comparison of the students according to their parents' assessments of the mathematical difficulties, hyperactivity, etc.; comparison of the students from the two groups according to their parents' assessments of the level of ambition and according to the aid the parents give to their children in preparing their school work mainly in Mathematics; difficulties in mathematics and language of the family members of the students from both groups (answers to the question "Did anyone in the family have difficulty in school during the school years?"); comparison of individual elements of the developmental history of the students from the two groups; comparison of the students according to their individual characteristics, preferences and interests; comparison of the performance of the students from the experimental control group after teaching intervention; comparison of the performance of the students from the control group before and after the didactic intervention of the experimental group; comparison of the performance of the students from the experimental group before and after the teaching intervention; comparison of the performance of the students from the experimental group immediately after teaching intervention and after six months; performance of the students of the two groups in algorithmic operations and problem solving; performance of the students from the experimental group in executing algorithmic operations and solving problems before and after teaching; comparison of the performance of the students from the experimental and control groups in executing algorithmic operations and problem solving.

The above mentioned results are impressive. They are justified in a suitable way and are of high quality. Concerning their quantity they exceed the requirements of a dissertation and even it seems that it is possible to use them not in one but in two separate dissertations in the domain at least.

5. Science-theoretical and practice-applicable contributions

Clearly formulated contributions of the dissertation are missing. It could be claimed descriptively that the science-theoretical and practice-applicable contributions are connected with the elaboration of the mathematical course and its teaching to students with dyscalculia. The corresponding teaching influence on the students positively, i.e. correctively taking into account the results of the assessments before and after teaching the proposed curriculum. The proven effectiveness of differentiated teaching strategies for students with dyscalculia contribute to making the educational system more inclusive. It is proven that students with dyscalculia can achieve not bad success in an inclusive environment if a differentiated approach is applied. It is established that the initial information connected with the goal of the proposed lessons and the corresponding conclusions at the end are important for the final positive result. The replies and the comments of the questionnaires are integrated in practical teaching. The dissertation sheds light on innovative and tailored teaching methods for students with dyscalculia. This leads to the possibility of developing new educational tools, resources, and teaching practices that can benefit not only students with dyscalculia but also other learners who have problems to understand mathematical concepts. Differentiated teaching, i.e., teaching-learning with inter-learning relationship, proves to be appropriate method to teach mathematical concepts and skills.

No doubt, the contributions of the dissertation are of a high level of utility.

6. Author's summary

The author's summary is in compliance with the content of the dissertation and enables establishment of a precise positive evaluation for its quality, topicality and purposefulness.

7. Publications about the topic of the dissertation (content and verification of the science-metrical requirements)

In total, 3 publications are presented in connection with the dissertation. All of them are independent. Approbation of the results obtained by the PhD student is assured. There is no reason to believe that they are not her personal work, which excludes a presence of plagiarism. The requirements for acquiring the educational and scientific degree "doctor" are satisfied.

8. Personal impression

I do not know the candidate personally.

9. Notes, recommendations and questions

The recommendations are connected with the necessity of clear formulations of candidate's claim concerning the contributions of the dissertation. I support all the proposals of Afroditi Kosma for implementation of the main results of the dissertation. One of them seems to be quite useful, namely the organization of training programs, workshops, seminars for

teachers and professors to enable teachers and parents to be informed about learning difficulties in Mathematics and their consequences, making known the results of the present research. Concerning directions of future research, some of them are formulated at the end of the dissertation and I do believe that Afroditi Kosma will do her best to realize them.

10. Conclusion

From all of the above it is obvious that Afroditi Lampros Kosma is a valuable specialist in Professional field 1.2. Pedagogy (Special education). Se has the necessary preparation and skills for independent research and scientific-practical activities. This makes me conclude that her quality and the quality of her dissertation satisfy the requirements of the ЗРАСРБ, the Regulations for its implementation, as well as the Regulations of Sofia University "St. Kliment Ohridski" for acquiring the educational and scientific degree "doctor". Therefore, I **declare my positive evaluation** for the executed investigation and I would like to propose to the honourable members of the Scientific Jury **to award** the educational and scientific degree "doctor" to Afroditi Lampros Kosma in the Field of higher education 1. Pedagogical sciences, Professional field 1.2. Pedagogy (Special education), Doctoral program "Special education in English".

Sofia, 23 January 2024

Author of the review:

(Prof. Dr. Habil Sava Grozdev)