R E V I E W

by Prof. Todorka Zhivkova Terzieva, PhD
FMI in University of Plovdiv "Paisii Hilendarski"

of a dissertation thesis for obtaining the Educational and Scientific degree "Doctor"

in the Area of Higher education: **1. Pedagogical sciences**
Professional field: **1.3. Pedagogy of teaching in….**
Doctoral program: **Methodology of teaching in Informatics and Information Technologies**

Author: Muharem Asanov Mollov, a full-time PhD student
Department: „Teaching in Mathematics, Informatics and Information Technologies" in FMI at University of Plovdiv "Paisii Hilendarski"
Topic: Methodological approach for implementation of competency-based training in the profession "Applied Programmer"
Scientific supervisor: Assoc. Prof. Gencho Dimitrov Stoitsov, PhD, University of Plovdiv "Paisii Hilendarski"

1. General description of the presented materials

By order № РД-21-439 of 24.02.2023 of the Rector of the University of Plovdiv "Paisii Hilendarski", I was appointed as a member of the Scientific Jury for a public defense procedure of a dissertation on the topic **"Methodological approach for implementation of competency-based training in the profession "Applied programmer""** for obtaining the educational and scientific degree "doctor" in the field of Higher education *1. Pedagogical sciences*; Professional Area *1.3 Pedagogy of teaching in…*, Doctoral program *Methodology of teaching in Informatics and Information Technologies.* The author of the dissertation is Muharem Asanov Mollov – PhD student in full-time form at the Department of Teaching in Mathematics, Informatics and Information Technologies of FMI, with supervisor Assoc. Prof. Gencho Dimitrov Stoitsov, PhD from University of Plovdiv "Paisii Hilendarski", Plovdiv. At the first meeting of the scientific jury I was chosen as a reviewer of the dissertation thesis, according to protocol № 1/28.02.2023.

The set of materials on electronic media, presented by Muharem Asanov Mollov is in accordance with the relevant law Art. 36 (1) of the Regulations for Development of the Academic Staff of University of Plovdiv (RDASPU). They are as follows:

1. An Application to the Rector of PU for the disclosure of the procedure for the defense of the dissertation.
2. CV in European format.
3. Protocols:
   3.1. Protocol №26-2022/2023, 21.11.2022 of the Departmental Council (from the preliminary discussion of the dissertation);
   3.2. Protocol №28-2022/2023, 24.01.2023 of the DC (proposal for a jury and date).
4. Abstract:
   4.1. in Bulgarian;
   4.2. in English.
5. Declaration for originality and reliability of the attached documents.
6. Reference for the compliance with minimum national requirements.
7. List of scientific publications on the topic of the dissertation.
8. Dissertation thesis.
9. Copies of the publications on the dissertation topic.
10. Official note from MHS "Acad. Cyril Popov" for participation in the NP "Training for IT skills and career".
11. Official note from the NPD of PU "Paisii Hilendarski" for participation in projects.
12. Set of documents on electronic media from items 1-11.

The documents submitted are precisely formatted and arranged in accordance with the attached list. The doctoral candidate has attached 8 publications on the topic of the dissertation.

2. Brief biographical data about the PhD student

Muharem Mollov graduated from the Natural Mathematics High School "Vasil Levski", Smolyan in 1991. In 1996, he graduated with a Master's degree, majoring in "Mathematics with a specialization in Informatics" at the FMI of Plovdiv University "Paisii Hilendarski" and acquired the qualification "Teacher of Mathematics and Informatics". In the period 1992–1994, he studied at PU "Paisii Hilendarski", majoring in "Marketing and Management" and acquired the "Marketing Specialist" qualification. In 2019, he acquired a third professional-qualification degree at Plovdiv University. In 2019, he completed a one-year professional-pedagogical specialization "Management of the school organization in the Information Society" at the PU. He has participated in more than 20 short-term and long-term professional-qualification courses and seminars.

During the period 1.03.2019-01.03.2022 Muharem Mollov is a full-time PhD student at the Department of "Teaching in Mathematics, Informatics and Information Technologies", PhD program "Methodology of teaching Informatics and Information Technologies".

Since 1997, he has been a teacher of Mathematics and Informatics in the secondary school "Hristo Botev", village of Chepintsi, municipality Rudozem. His professional activity is related

to planning, preparation and teaching of mathematics, informatics and IT curriculum to students. He is involved in a number of national programs and projects – NP "Training for IT skills and career", NP "Education for tomorrow", NP "Equal access to school education in times of crisis", he was a trainer of teachers for acquiring digital competencies, as well as a participant in projects at the NPD of PU.

For his highly professional activity in the system of public education Muharem Mollov was awarded a diploma by the Ministry of Education and Science – Regional Education Management in Smolyan.

3. Relevance of the topic and expediency of the set goals and objectives

Modern information and communication technologies are changing the model of education on a global scale in search of ways to achieve better quality of education. The new and rapidly changing content of informatics and IT education requires the development of methodologies that ensure not only the reproduction of a large volume of knowledge, but above all methodologies that form and develop competencies that allow students to actively acquire knowledge, to build problem-solving skills, creativity, critical thinking, etc. On the other hand, the software business sets requirements for students' realization on the labor market – ability to work in a team; skills for structuring and presenting information; communication and cooperation skills, etc. The application of a competence approach in education is essential for the formation of students' skills for the practical application of the acquired knowledge and skills.

The dissertation work developed by Muharem Mollov is related to a topical problem for education – a need to develop and implement methodological approaches for the development of specific professional competencies in the training of students. In the introduction the aims and objectives of the research, object, subject and hypothesis of the research are well defined. The main objective of the dissertation is to develop and approbate a methodological approach for implementation of competency-based training of students in the profession "Applied Programmer", including an appropriate toolkit for developing and diagnosing the professional competencies for software development set in the curriculum. In order to achieve the set objective, three tasks with several sub-tasks have been formulated, which adequately reflect the planned activities and correspond to the set goals.

4. Knowledge of the problem

The doctoral candidate has carried out a theoretical analysis and review of 184 literature sources, 77 of which are in Cyrillic, 107 in Latin and 47 Internet sources on the topic of the dissertation, of the Internet sources 21 are in Cyrillic and 26 in Latin. A significant number of Bulgarian and foreign authors have been correctly cited. The dissertation work is the result of a thorough study of the considered problems and creative application of the acquired knowledge

and skills. There are reasons to believe that the PhD student is well aware of the European framework for digital competence and benefits from it. Muharem Mollov demonstrates theoretical and practical skills to independently conduct a comprehensive scientific research.

5. Research methodology

The dissertation research used a set of activities to collect empirical data, such as theoretical analysis and research on pedagogical experiences, and also their processing through mathematical-statistical analysis. The methodological approach used to carry out the research is a diagnostic procedure to control knowledge, skills and competencies. Theoretical and empirical research methods were used to realize the aims and objectives and to test the hypothesis: observation, comparison, analysis, synthesis, modeling, theoretical generalizations, discussions with current informatics teachers and tests. The PhD student also used personal experience in teaching informatics and information technology in school, partially structured observation, self-assessment and expert evaluation of the competence of the trainees. A didactic experiment was made and mathematical-statistical methods were applied to process the experimental data. The toolkit used includes a set of tasks, quizzes and exams to test students' knowledge and skills and a student self-assessment survey. The chosen research methodology allows achieving the set goals and objectives.

6. Characteristics and evaluation of the dissertation

The dissertation of Muharem Mollov presented for review is structured in the following parts: introduction, three chapters, conclusion, references and three annexes. It contains a total of 168 pages, with 138 pages of main text, 16 pages of references and internet sources, and 14 pages of appendices. The text is illustrated with a large number of figures that demonstrate the application of the developed methodological approach. Main contributions, list of publications on the thesis, approbation of results, declaration of originality, perspectives for future development and acknowledgements are added.

The introduction presents the relevance of the research, subject, object, objectives of the research and structure of the dissertation.

Chapter I provides an overview of the study of computer science and programming in global and national contexts. Current trends in the study of computer science and the application of the concepts of a competency-based approach to learning are discussed. An outcome framework of required competencies for software developers is presented and used as a basis for the implementation of a methodological approach for competency-based training for student in the profession of “Applied Programmer”.

Chapter II presents the methodological approach developed by the author for competency-based training in the profession “Applied Programmer”. Emphasis is placed on the proposed model for collaborative blended learning at a distance in an electronic environment.

The didactic materials for training developed by the author (a set of tasks for the development and assessment of selected specific competences in the profession "Applied Programmer" and an example project for project-based learning of a training module) are also presented. A methodology for creating tasks for the different modules of the training is presented. A methodology for teaching by partial modification of the classical ADDIE model of training is implemented.

Chapter III presents the organization, results, analysis and conclusions of the study. The analysis is based on the results of a two-stage assessment of professional competencies in the areas of Algorithms and Data Structures, self-assessment, and expert learner assessment. The didactic experiment has been implemented in the training of students in groups in the Mathematics High School "Acad. Cyril Popov", Plovdiv, PGEE "Konstantin Fotinov", Burgas and High School "Hristo Botev", village Chepintsi, Smolyan region. Details related to the planning and organization of the pedagogical experiment are presented, as well as criteria and indicators for evaluating the effectiveness of the proposed methodological approach. The results of the study are statistically processed and analyzed, conclusions and implications regarding the working hypothesis are formulated.

The Conclusion presents the results achieved, formulates the main contributions, provides a list of publications and reports on the results of the dissertation, 11 citations are listed and some perspectives for future development are presents. In the Appendices, a pre-test used for training and evaluation and sample solutions to the tasks for the development of professional competences are included.

7. Contributions and significance of development for science and practice

The main contributions resulting from the dissertation thesis are of scientific-applied and applied nature, and can be formulated as follows:

1) A methodological approach for competency-based training for the profession of „Applied Programmer“ in secondary vocational education through a technological environment for collaborative blended learning with more than one learner with the possibility of distance collaboration in an electronic environment is proposed and tested.
2) A methodology for creating tasks for the different modules of the training is presented. A teaching methodology has been implemented through a partial modification of the classic ADDIE model of learning.
3) A set of tasks for the formation and development of specific competences in the profession „Applied Programmer“ has been developed and tested.
4) A pedagogical experiment was implemented to carry out a diagnostic procedure with subsequent analysis of the results.

The relationships between the contributions, the tasks, the place of description in the thesis and the publications made are described in a table. I believe that the above contributions are sufficient for the award of the educational and scientific degree “Doctor”.

8. Evaluation of the dissertation publications

PhD candidate Muharem Mollov has submitted 8 publications on the topic of the dissertation in peer-reviewed publications. It is noteworthy that 6 of the publications are indexed in Web of Science (3 in Journal „Mathematics and Informatics“, 1 in the Journal „Strategies of Education and Science Policy“, 2 in TEM Journal (Q3 SJR 2021: 0.245), 2 publications are in the Proceedings of the Anniversary International Scientific Conference „Synergetics and Reflection in Mathematics Education“, 16-18 October 2020, Pamporovo, Bulgaria. This fact is sufficient as a quantitative and qualitative criterion for obtaining a educational and scientific degree „Doctor“. The presented publications can be separated as follows: 6 articles in journals, 2 in Proceedings of an International Scientific Conference; 5 of the publications are in English, the rest are in Bulgarian; 2 are independent, 6 publications are co-authored, with one co-author there are 4 articles, with two co-authors – 1, with more co-authors – 1. In these publications Muharem Mollov is the first author in 5 of them.

A review of the submitted documents shows that the PhD student meets the minimum national requirements (110 points) and significantly exceeds the minimum of 30 points set out in the regulations for the implementation of the LDASRB. There is sufficient approbation of the dissertation results. This is evidenced by the 11 citations of his publications, 4 of them in English, 1 in a journal indexed in Web of Science.

9. Personal participation of the PhD student

The presented publications on the topic of the dissertation research, two of which are independent, demonstrate the indisputable personal contribution of Muharem Mollov for creation and application in the educational practice of a developed methodological approach for competency-based learning. It is noteworthy that the mentioned publications purposefully present separate parts of the dissertation research. The high professional qualification of Muharem Mollov is the grounds for conducting scientific research independently as well as formulating the obtained results. I have not discovered any plagiarism in the materials submitted to me for review.

10. Abstract

The submitted abstract is prepared in accordance with the requirements, consists of 32 pages and correctly reflects the content and structure of the dissertation work, presenting the main results achieved in the dissertation research.

11. Critical remarks, questions and recommendations

I recommend the PhD student to continue the research and to create a system of tasks for the development of specific professional competences for the profession „Applied Programmer", as well as qualitative criteria for the evaluation of the achieved results. I hope that Muharem Mollov will realize his declared perspectives for future research development.

12. Personal impressions

My impressions of the provided materials are for an established professional with in-depth knowledge and skills and active participation in National Programs and Projects implemented at school. The results achieved by Muharem Mollov demonstrate his ability for effective problem solving related to the educational process.

CONCLUSION

The dissertation of **Muharem Asanov Mollov contains scientific-applied, and applied results, which represent an original contribution to science and meet** the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria (LDASRB), the Regulations for application of LDASRB and the respective Regulation on the Development of the Academic Staff in University of Plovdiv "Paisii Hilendarski".

The dissertation shows that the doctoral student – **Muharem Asanov Mollov** has a profound theoretical knowledge and professional skills in the Methodology of teaching Informatics and Information technologies, as demonstrated qualities and skills to independently conduct research.

Due to all of the above, I confidently give my **positive assessment** of the research presented by the above peer-reviewed dissertation thesis, abstract, achieved results and contributions, and I **propose to the Honorable Scientific Jury to award the educational and scientific degree "Doctor"** to **Muharem Asanov Mollov** in the Area of Higher education 1. **Pedagogical sciences**; Professional field 1.3.; **Pedagogy of teaching in….,** Doctoral program **Methodology of teaching in Informatics and Information Technologies**.

19.04.2023 Reviewer: .....

Plovdiv (Prof. Todorka Terzieva, PhD)