

The System for Monitoring the Quality of EMC Msc Programs Implementation

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Abstract — The paper considers the importance of training specialists in electromagnetic compatibility (EMC) and presents Master's programs, specialized in Electromagnetic compatibility, implemented in Tomsk State University of Control Systems and Radio Electronics (TUSUR). A system for monitoring the quality of implementation of Master's programs in EMC is proposed. The main advantages and disadvantages of the implementation of Master's programs in EMC are presented. A set of measures has been developed to improve the quality of the implementation of master's programs. Partial implementation completed. A comparative analysis of the quality assessment of the implementation of master's programs for the last 2 years is presented. The scientific results and successes of students after the introduction of a new model of research work are presented. An increase in indicators was identified after the implementation of a set of measures to improve the quality of the implementation of master's programs. The importance of introducing the education quality assessment is shown.

Keywords — electromagnetic compatibility, Master's programs, quality of education.

I. INTRODUCTION

Due to the massive proliferation of technical means consisting of microprocessor devices, high-frequency circuits and low-power transmitters used in household appliances, the automotive industry, etc., which we have been witnessing in the last decade, compliance with electromagnetic compatibility requirements is becoming more and more difficult. Moreover, the number of aspects taken into account is growing rapidly. The problem of providing EMC is closely related to what constitutes a vast field of radio engineering, electronics, and electrical engineering. EMC issues are receiving more and more attention worldwide [1]. Back in 1992, Paul's book [2] became the most popular foreign textbook on EMC. Therefore, the question of training specialists in various EMC profiles is getting especially important.

II. IMPLEMENTATION OF EMC MASTER'S PROGRAMS

For the first time in Russia, Tomsk State University of Control Systems and Radio Electronics (TUSUR) began to train EMC specialists [3–5]. In 2016 the Department of Television and Control began to implement a Master's program in electromagnetic compatibility. Since 2017, 3 Master's programs have been implemented: "Electromagnetic Compatibility of Radioelectronic Equipment", "Electromagnetic Compatibility in the Fuel and Energy Complex", and "Protection against Electromagnetic Terrorism". Since Master's programs are new and unique, special attention should be paid to assessing the quality of education and their improvement. A number of questions on assessing the quality of the

educational process have been considered earlier in [6 - 9]. However, their systemic generalization in a single work is absent. As part of the education quality assessment, the following was performed:

- The main criteria for assessing the quality of the educational process has been considered.
- The quality of Master's programs implementation at the Department of Television and Control in the 2017/2018 academic year has been assessed.
- A set of measures to improve the quality of Master's programs implementation in the 2018/2019 academic year has been developed.
- A repeated questionnaire to assess the quality of the educational process among graduate students [10 - 14] has been conducted.

However, a complete comparison of the results of the student survey conducted in the 2017/2018 and 2018/2019 academic years hasn't been made. Meanwhile, this becomes relevant, as it will allow showing the effectiveness of the set of measures for improving the quality of implementation of Master's programs and for providing a timely feedback to identified shortcomings in the learning process. According to the decree of the Government of the Russian Federation [15], the activities for monitoring the quality of the educational process must be carried out at least once a year. At the Department of Television and Control, the monitoring system has been employed for 2 years.

The purpose of the work is to conduct a comparative analysis of the results of assessing the quality of educational services among graduate students doing EMC programs.

III. SYSTEM FOR MONITORING THE QUALITY OF IMPLEMENTATION OF MASTER'S PROGRAMS

When developing the assessment system, the following aspects were used [10, 11]:

- Material, technical and information support of the department.
- Conditions for individual work of teachers with students.
- Competency of teachers of the department.
- Approaches used in the educational process.
- Satisfaction with the theoretical and practical content of the program.
- Value and importance of the Master's program done by a student.

After the first quality assessment (in the 2017/2018 academic year), the following disadvantages and advantages were identified [11].

Disadvantages: uninteresting presentation of information, narrow specialization, “outdated” format of work.

Advantages:

- New and promising areas of training.
- Opportunity to engage in research activities and participate in the implementation of grants.
- Possibility to be employed in a research laboratory while pursuing a master's program.

To improve the quality of the training graduate students, the recommendations presented in [12] were proposed and partially introduced into the educational process.

Recommendations for improving the quality of the educational process:

- To revise the format of work with undergraduates, including formats for the presentation of information in the classroom.
- Improve the material and technical base, which students use in the classroom.
- To develop testing to verify the residual knowledge of students in order to conduct systematic monitoring of the quality of the educational process.
- To ensure the balance of research and practice in the master's programs of the department.
- Organize work on the Internet to disseminate information about the activities of the department and the achievements of students [12].

To identify the effectiveness of the implemented recommendations and assess the quality of master's programs in the 2018/2019 academic year a repeated questionnaire survey of graduate students of the department of TU was conducted. The analysis of the survey results showed an improvement in indicators. Satisfaction with the educational process increased by 8.7%. Correspondence of the education being received to further employment plans increased by 13%. However, the number of students for whom their education does not meet further employment plans increased by 11%. This indicator shows the need to review the system of selecting applicants for graduate studies. The assessment of the material and technical facilities did not change significantly.

The results of the repeated questionnaire and the survey conducted in the 2017/18 academic year are compared in Table I [13].

TABLE I. COMPARISON OF TWO QUESTIONNAIRES RESULTS

Criteria for evaluation	Answer options	2017/2018	2018/2019
Satisfaction with the educational process	Satisfied	46.3 %	55 %
	Rather satisfied	41.5 %	31 %
	Rather dissatisfied	12.2 %	14 %
	Dissatisfied	0 %	0 %
Correspondence with further employment plans	Corresponds	25 %	38 %
	Corresponds well	47.5 %	41 %
	Does not really correspond	17.5 %	0 %
	Does not correspond	10 %	21 %
Quantity of equipment needed	On a five point scale	3.8	3.8
Quality of equipment used		3.5	3.1

For a more complete assessment of the quality of the implementation of master's programs, a second questionnaire was also conducted among the teachers the Department of Television and Control, who are direct participants of the educational process and who provide the quality of the educational services. When conducting a questionnaire survey in the 2017/2018 academic year, teachers noted a low level of students' motivation in getting education and the lack of awareness in choosing a Master's program. When assessing the material and technical facilities, the following results were obtained: according to the criterion "quantity of necessary equipment" - 3.04 points out of 5 possible; according to the criterion "quality of equipment used" - 2.96 points. When evaluating the educational and methodological support, the following results were obtained: according to the criterion "the availability of educational and methodical literature" - 3.75 points, according to the criterion "the quality of educational and methodical literature" - 4 points.

The main disadvantages of the master's programs at the department the teachers referred:

- Imbalance of research and practice.
- Lack of specialized laboratories and new equipment.
- The main advantages of the master's programs of the department the teachers included.
- Assignment of each first-year graduate student to a specific teacher with his/her own scientific subject.
- Good research facilities and the opportunity to participate in research projects.
- Demand for specialists with MSc Degree in Electromagnetic Compatibility.
- Use of advanced scientific research in the educational process [12].

When conducting a questionnaire survey in the 2018/2019 academic year there was a decrease in the level of knowledge and skills of applicants for the MSc programs. The main reason that impedes the effectiveness of training still remains students' disinterest in the educational process. This was one of the reasons why the Department of Television and Control introduced a new bachelor's program "Electromagnetic Compatibility" within Radio Engineering training program. This profile will equip students with a basic set of knowledge and skills in the field of EMC and will provide a higher level of training for those students who will pursue to the Master's program.

When assessing the material and technical facilities, the following results were obtained: according to the criterion "quantity of necessary equipment" 3 points out of 5 possible were obtained, according to the criterion "quality of equipment used" - 2.78 points. When evaluating the educational and methodological support, the following results were obtained: according to the criterion "the availability of educational and methodical literature" - 3.64 points, according to the criterion "the quality of educational and methodical literature" - 3.6 points. The indicators of the assessment of material and technical support and educational and methodological support obtained during the repeated questionnaire did not change significantly, which indicates the need for updating them, which can also contribute to increasing the interest of students in getting education in this profile.

In addition, the teachers, like the students, consider the opportunity for students to participate in research projects and their employment in a research laboratory to be a great advantage of master's programs.

IV. SCIENTIFIC WORK AND SUCCESSES OF STUDENTS

Education for the MSc Degree includes research work, which in educational institutions is implemented in various ways. The Department of Television and Control provides students with the opportunity to engage in research work, attracting them to participate in research projects and employing them in the research laboratory [11, 14, 16]. Such cooperation is beneficial both for the student and for the laboratory. The student receives new knowledge, professional skills, acquires working experience, which is important for subsequent employment, receives additional income, has the opportunity to write scientific articles and speak at conferences, publish in journals, and become a scholarship holder of various programs [14]. This practice has entrenched in the framework of research work and has proved itself among graduate students. This is evidenced by their scientific achievements, presented below.

During the academic years 2017/2018 and 2018/2019, students published 6 scientific reports to the 23rd international scientific-practical conference "Natural and Intellectual Resources of Siberia (SIBRESURS-23-2017), 6 scientific reports to the same conference in 2018, 9 reports to the XII international scientific-practical conference "Electronic Tools and Control Systems", 21 reports to the same conference the following year, 27 reports to the international scientific-practical conference of students, graduate students and young scientists

"Scientific Session of TUSUR-2018", 3 abstracts on scientific O-Technical Conference of Young Specialists "Electronic and Electromechanical Systems and Devices." A report in English on "Moscow Workshop on Electronic and Networking Technologies (MWENT – 2018)" is indexed by Scopus and Web of Science. In addition, 2 reports were published in the international journal "Journal of physics: conference series" (Scopus and Web of Science) and 1 article in the Russian journal from the list of the Higher Attestation Commission "Siberian journal of science and technology", and a certificate of state registration of the program was received for computer No. 2016811481 TALGAT 2017. As a result, in the 2017/2018 academic year, 8 people became recipients of an increased academic scholarship for achievements in research activities, 6 people became recipients of a scholarship from the Government of the Russian Federation in priority areas and 2 people became recipients of a scholarship of the RF President in priority areas. In the 2018/2019 academic year, 8 people received scholarships for academic excellence in research activities, 4 people received scholarships from the Government of the Russian Federation in priority areas and 1 person received a scholarship from the V. Potanin Foundation. The results of the work done by the students were included in the reports on applied research and patent research reports on the project under the federal target program "Research and Development in Priority Directions for the Development of the Russian Science and Technology Complex for 2014 - 2020". At the same time, the contribution of graduate students to the preparation of reports was significant.

V. CONCLUSION

A comparative analysis of assessing the implementation of Master's programs at the Department of Television and Control in TUSUR is presented. Regular activities on monitoring the education quality assessment allowed us not only to regularly monitor the quality of education and the level of students' satisfaction of the educational process, but also to timely develop the measures necessary to improve the educational process system. The results of this work seem to be useful for other departments, faculties and universities. The assessment system used can also be used for undergraduate and specialist programs.

Acknowledgment. The study was supported by the state contract 8.9562.2017/8.9 of the Ministry of Education and Science of the Russian Federation.

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