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EVALUATION OF THE PILOT ONLINE SHORT CYCLE PROGRAM "PROGRAMMING IN JAVA"

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Abstract: *This paper presents an evaluation of the short program "Programming in Java" implemented at Belgrade Metropolitan University (BMU) as a pilot program of the project "Introduction of part-time and short cycle studies in Serbia" (PT&SCHE), funded by Erasmus+ European Union program and in realization from October 2015 to May 2018. PT&SCHE role is to prepare a legal framework for the introduction of short programs and part-time study programs primarily intended for both: (i) employed students who can't study regularly or those who want to improve their qualifications, and (ii) unemployed students who want to gain new competences for better jobs offered by the labor market. In order to provide a legal framework, it is very important to analyze the existing methodologies, techniques and best practices of PT&SCHE studies that are already been applied in other countries. Based on the analysis of the most appropriate model for the adoption and development of PT&SCHE in Serbia, this paper aims to analyze and discover the most relevant pedagogical and methodological approach in eLearning processes of short programs. This paper describes the teaching methodology and e-learning technology proposed and implemented by BMU for short cycle programs (SCHE). The paper also analyzes effects to students (their success and satisfaction), provides an evaluation of applied methodology the pilot phase of the short program "Programming in Java" realized by BMU.*

Keywords: *E-Learning, Short cycle program, PT&SCHE project*

1. INTRODUCTION

The Strategy for the Development of Education in the Republic of Serbia by 2020 identifies the need for part-time (PT) and short cycle (SCHE) studies, and appropriate action plans were adopted [1]. The Low for Higher Education, adopted in 2017, provided the legal bases for PT and SCHE studies [2]. The PT&SCHE Erasmus+ project [3] aims to implement these action plans necessary for the establishment of PT&SCHE studies in Serbia, providing the proven legislative frameworks. The results of the project will contribute to achieving the goals of the strategy, such as extending access to higher education, and adapting higher education to the labour market. The project is funded under ERASMUS+ program of the European Union, for realization in a consortium of 15 partners from Estonia, Great Britain, Netherlands, Hungary, Slovenia and Serbia.[1]

A short program enables a student to become capable of performing a particular job (for example, a Java programmer), as opposed to 3 or 4 year study programs that educate a student for a specific profession in a particular field (e.g. Information Technology Engineer) . In this sense, the program is a set of courses that provide students with qualifications for a particular job within 3 to 12 months. While study programs of basic and master studies, for a period of three or four years, train a student for jobs in one profession (for example, software engineering), a short program provides within 12 months a student for a particular job within a profession (eg, Java programmer).

Depending on the complexity of the work a student is studying, a short program can provide a qualification for a particular job, within a profession, at the 5th, 6th or 7th level of the European Qualification Framework (EQF) [4].

As general goals of PT&SCHE are to support widening access to high education, and making it more relevant and adaptable to the labour market, it was important to:

1. define the legal framework supporting the development and implementation of part-time (PT) studies and short cycle (SCHE) studies in higher education in Serbia,
2. define and develop online and face-to-face (F2F) learning methodologies and technologies for PT&SCHE, suitable for adults working students and
3. develop pilot implementations of five PT&SCHE online and face-to-face programs and at the end to analyze project outcomes and effectiveness of the

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proposed legislation, adopted pedagogical and technological solutions in order to review the guidelines of PT&SCHE studies based on gained experience.

Based on existing methodologies, technologies and best practices for PT&SCHE studies, in European Higher Education Area (EHEA) and European Association of Institutions in Higher Education (EURASHE), SCHE implementation and best practices in member countries was analyzed [5]. Suitable models and online face-to-face (F2F) learning methodologies and technologies for PT&SCHE studies will be adopted and developed. Project participants from Programme Countries are not only involved in the analysis and transfer of best practices from EU, but they are also our advisors for choosing and adopting the most relevant pedagogical and technological solutions by giving advices in five pilot implementations of online and face-to-face PT and SCHE programs.

As the member of the project consortium, Belgrade Metropolitan University (BMU) was given the task to implement one of first pilot SCHE programs in Serbia. After an analysis of current labour market needs, BMU decided to develop a pilot SCHE program named "Programming in Java" with the aim to develop and test the most suitable methodology for SCHE programs. SCHE program "Programming in Java" was developed under the special control of project. This SCHE has passed also the standard internal review of BMU. In addition to the carefully prepared curriculum, lecturers and tutors were carefully selected from faculty members of BMU. This work represents evaluation of applied methodology of whole eLearning process during the pilot phase of realization program on BMU with the aim to define in what extent the proposed methodology was successful and what is to be changed in the future. This paper is organized as follows. Section 2 describes technical details of curriculum and training details of the pilot online program "Programming in Java". Section 3 describes the teaching methodology applied on short cycle program. Section 4 shows the evaluation of applied methodology. Section 5 concludes the paper.

2. THE CURRICULUM

Based on the European ICT Professional Profiles [6], which defined 23 work profiles, i.e. jobs at the first two hierarchical levels, leaving the third level to be define by ICT companies and ICT educators. According to this, BMU specified the job profile: "Java programmer" at the third level and launched the SCHE program "Programming in Java" to provide necessary competences its learners aiming to work as Java programmers. "Java Programmer" is the specialization of the work profile "Developer", specified at the second level of ICT work profiles.

European ICT Professional Profiles specifies, for each workplace, the following: job description, performance, main tasks and competencies, in the form of e-competences defined in the document *E-Competence Framework (e-CF)* [7]. For the *Developer* position, it has been defined that it must have five e-competencies (B.1, B.2, B.3, B-5 and C.4) listed in the *E-Competence Framework document (e-CF*) [7]:

1. B.1. Design and Development
2. B.2. Systems Integration
3. B.3. Testing
4. B.5. Document Production
5. C.4. Problem Management.

The short program of the BMU called "Programming in Java" educates students get competences for work profile "Java programmer" within 12 months in accordance with the following de facto standards:

- E-Competence Framework (e-CF) [7]
- European ICT Professional Profiles (CWA 16458) [6]
- Foundational ICT Body of Knowledge [8]

The program content, i.e. body of knowledge (BOK) of SCHE program "Programming in Java" has been developed having in mind, the following recommendations of professional organizations IEEE Computer Society and American for Computing Machinery (ACM):

- Computer Science Curricula 2013 [9] - Curriculum Guidelines for Undergraduate Degree Programs in Computer Science, December 20, 2013,
- Information Technology Curricula 2017 - IT2017 Curriculum Guidelines for Baccalaureate Degree Programs [10],
- SWEBOK V3.0 [11] - Guide to the Software Engineering Body of Knowledge,
- Enterprise ITBOK [12].

SCHE Program "Programming in Java" enables:

- Employed students to study and work simultaneously, because teaching is done partially online, i.e. via the Internet using the BMU eLearning system, and partially F2F (workshops);
- Unemployed students to qualify for Java developer, even in a shorter time than 12 months;
- Practical work in BMU computer classrooms within the workshops, for a total duration of 32 days (alternatively, students who cannot realize workshops on BMU can also realize them online);
- A two months internships in companies developing Java applications, at the end of the program.

The level of knowledge and capabilities of the "Java programmer", who completes this program: the initial, but with the possibility of rapid promotion after acquiring a relevant work experience, because the program content of the short program allows acquiring knowledge to the required programmer at the intermediate level of knowledge and skills.

By analyzing the curriculum of existing courses of academic programs of bachelor degree programs of BMU, their learning objects (LOs) of interest have been identified, i.e. those who give the required competencies.

The curriculum of SCHE program "Programming in Java" is determined by the mapping of relevant parts of the BMU Bachelor's degree programs.

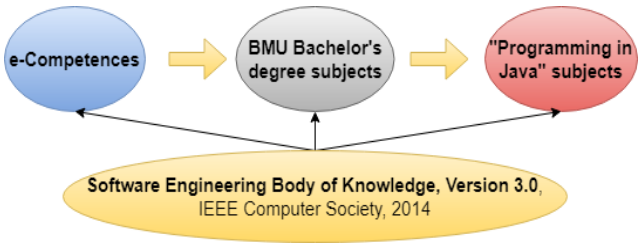

Figure 1: Procedure for determining the subjects of the short program "Programming in Java" and their program contents, as well as the learning outcomes

Figure 1 shows the procedure for development of SCHE Program "Programming in Java" curriculum. It is implemented in three stages where each of them has one or more courses:

1. **Preparatory stage** – aiming to prepare trainees for programming training, providing the some basic knowledge in IT systems and programming fundamentals. The following courses are included:
    a. KI101 Introduction to IT systems
    b. KI102 Fundamentals of Programming
2. **Learning stage** – providing programming knowledge and skills to trainees, as well as some basic soft skills that might be useful for their employability. This stage includes:
    a. KI103 Java 1: Fundamentals of Programming
    b. KI104 Java 2: Object-oriented Programming
    c. KI105 Java 3: GUI Programming
    d. KI201 Java 4: Data Structures and Algorithms - Part A
    e. KI202 Java 5: Data Structures and Algorithms - Part B
    f. KI203 Java 6: Advanced Java Programming
    g. KI204 Java 7: Java Enterprise Edition
    h. KI205 Java 8: Java Programming on the Android platform
    i. KI206 Software Development Process and Methodology
    j. KI301 Software Construction
3. **On-the-job training stage** – providing trainees one course (KI401) and one internship (KI402):
    a. KI401 Software Development Project
    b. KI402 Professional Internship - Java Developer

Figure 2 shows the table with course hours of all listed courses.Figure 3 shows courses offered as electives. These are selected online courses of regular BSc programs of BMU.

In creating a short program, several IT firms, especially those dealing with software development using Java technology, have been consulted to ensure that this short program is created by "tailor-made employers" who need to hire students who complete this program. The final quality indicator of realized short program is the percentage of student employment in the first three months after the completion of the short program. For each of the above defined courses, program contents and learning outcomes are defined, so in the end, they provide the required competencies for the Java programmer work profile.

#	Course	Duration (Days)	Teaching Days	Workshop Days	Teaching Hours	ECTS
1	Introduction to IT systems	15	14	0	42	4
2	Programming Fundamentals	11	8	2	30	3
3	Java 1: Fundamentals of Programming	17	14	2	48	5
4	Java 2: Object-oriented programming	13	10	2	36	3
5	Java 3: GUI Programming	17	14	2	48	4
6	Java 4: Data Structures and	16	13	2	45	4
7	Java 5: Data Structures and	16	13	2	45	4
8	Java 6: Advanced Java Programming	15	12	2	42	4
9	Java 7: Java Enterprise Edition	24	21	2	69	7
10	Software Development Process and	18	15	2	51	5
11	Software Construction	21	18	2	60	6
12	Elective Course	24	23	0	90	8
13	Intership (8 weeks)	40	0	0	0	3
	TOTAL:	**247,0**	**175,0**	**20,0**	**606,0**	**60,0**

Figure 2: Online teaching hours and ECTS of the courses of the SCHE program "Programming in Java"

No.	Elective online courses (Students select one course)	Number of Hours	ECST
1	CS323 C/C++ Programming Language	90	8
2	CS322 Programming in C#	90	8
4	IT381 Information Security and Safety	90	8
5	IT150 Database	90	8
6	SE321 Quality Assurance, testing and maitenance	75	8
7	IS345 Digital Content Management	75	8

Figure 3: Electives courses of the SCHE program "Programming in Java"

The program provides 606 hours of active teaching and 60 ESPB, i.e. credits that can be recognized if the student decides to enroll later on one of four BSC degree programs of BMU: Software Engineering, Information Technology, Computer Games and Information Systems. In the normal duration of the 12 month program, students will have: nine months for active learning, two months of internship and one month for annual leave. Learning is performed in blocks, i.e. according to the "course-by-course" system. It is planned that on each course, a student spends at least three hours a day. Including Saturdays (or 18 hours per week) using the e-Learning System of BMU. Figure 4 shows the table with start and end days of major groups of training activities of the SCHE program "Programming in Java", lasting, in total, 12 months and providing 60 ECTS.

	Start Date	End Date
Introdutory courses	1.10.2017	5.11.2017
Online training courses	7.11.2017	13.7.2018
Summer Holidays	15.7.2018	5.8.2018
Internship (8 weeks)*	8.8.2018	28.9.2018

* Student has to realize its 8 weeks intership in this perod

Figure 4: Start and end dates of training activities

Learning material provided by the BMU's e-Learning System contains web pages with multimedia contents (text, figures, Java codes, video and audio content), but also a PDF version of each lesson, the textual part of each lesson in PDF format (as an additional teaching material), and the student is not required no additional literature (although it is always useful to use other sources of knowledge). In addition to online classes, a two-day workshop in the computer classrooms of the University is planned for each course. All students get work assignments (as home works) and one project per course. If a student is prevented from participation in workshops, this/her workshops can also be organized online. After the completed project and all assignments and tests that are being evaluated, the student takes the exam of each course.

After successfully completing professional practice on every course, the student receives the Certificate of Successful Completion of the Short Program, with an appendix containing the obtained grades on all subjects of the Short Program with a list of course learning outcomes and competences.

3. TEACHING METHODOLOGY

The Java Programming training program uses the following structure of activities (Figure 5):

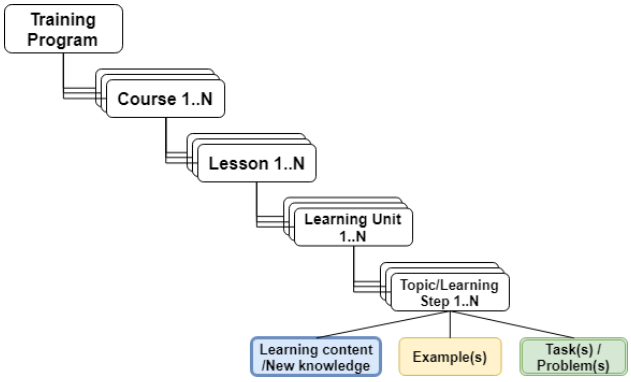

Figure 5: The structure of Java Programming Training Program

The Training Program consists of Courses. Each Course has a different number of Lessons. A Lesson describes the objectives, procedures, materials and evaluation for a particular class or a particular day. Each Lesson consists of one or more Learning Units. A Learning Unit provides a new and short concept depending on the content. Each Learning Unit has a clear learning objective regarding to change the level if knowledge and skills of trainees. A Learning Units consists of one or more Topics. A Topic or Sub-Topic is an atomic learning concept with a clear learning outcome. Especially for SCHE programs BMU decided to implement a "Step-By-Step" learning methodology. Each Step provides a small chunks of new knowledge to trainees, related to a Topic, and immediately followed by one or more given examples (solved problems) and by tasks or (unsolved) problems that trainees have to solve by using this newly acquired knowledge.

Figure 6 shows Learning Units with their Thematic Steps (Topics), each with three types of sub-steps:

- New knowledge acquisition (a learning concept) – a small chunk of new knowledge or a new concept
- Presentation of examples of solved problems demonstrating use of new knowledge
- Tasks (unsolved problems) to be accomplished by each learners – given problems to solve

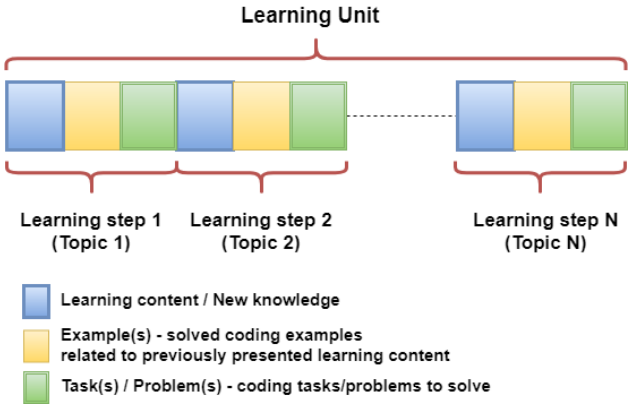

Figure 6: A Learning Unit and its steps and sub-steps

The "Step-By-Step" learning methodology has been developed by BMU for SCHE programs aiming to provide high level of applied knowledge (Bloom Level 3). A trainee learns how to implement newly acquired knowledge, as a trainee must demonstrate his implementation capability by solving given problems. The granularity of Topics/Learning Steps should be as small as feasible, in order to achieve high level of integration of knowledge acquisition and its application activities. A Learning Path of a trainee is a Learning Process leading to the Learning Goal (achieving an appropriate knowledge and capability level) consisting of many Learning Activities related to hierarchically structured knowledge (Learning Units/Topics/ Sub-Topic).

BMU has structured its learning materials according to requirement of the "Step-By-Step" methodology. BMU has a large repository of Learning Objects (LOs) ("any entity, digital or non-digital, that may be used for learning, education or training" [13]) – one for each Topic or Sub-Topic. Use of Learning Objects (LO) with fine granularity, allows easy configuration and generation of new learning material specifically created for a specific Study or Training Program. Use of LOs with fine granularity provides also a high reusability of the existing and previously developed LOs. An appropriate Learning Material may be efficiently developed for new Curriculum with high degree of reusable learning objects. Implementation of the concept of LOs, with fine granularity, BMU is able to create in few weeks the learning material for "Programming in Java" training program and its curriculum. Online delivery of learning material by using BMU eLearning System, provides an efficient mechanism for delivery of learning materials to all trainees, and their additional interaction using its interactive activities.

4. EVALUATION

During the pilot phase, through all courses, learning activities were logged in the eLearning system (LAMS v3.0) including: time spent on learning online materials, the number of solved tasks and assessments, as well as other interactions with the resources provided by eLearning system. Information system of BMU (ISUM) tracks all marks and other data about progress of students by course, such as: number of points per tests and projects, the number of points scored in the exam and the final grade. In the process of evaluation is included 8 trainees who passed the entire training process.

Five trainees gave up at the beginning of the course. Their reasons for giving up are of personal nature, so we will not take them into account during the analysis. It is important to note that at the time this paper was written (September 2018), only two students successfully passed all the exams in the first test period, and six more has to pass the correction exams. In order to analyze relatively poor results in the first test period (only 25% successfully passed all exams), we analyzed the use of learning materials and other activities provided by the eLearning system in order to determine the extent to which the system was used and what resources were most used.

Comparing the time spent in learning and number of failed exams, it is evident that trainees T3 and T8 spent less time in learning from others who have fewer failed exams. In this part, it is very important in some way to motivate students to use the e-learning system to a greater extent.

Table 1: Time spent in learning by trainee

	Number of failed exams (max 13)	Projected learning time in hours	Time spent in learning
T1	0	606	780
T2	3	606	585
T3	8	606	120
T4	0	606	980
T5	2	606	780
T6	3	606	330
T7	3	606	300
T8	8	606	80

At the end of the evaluation, trainees were asked to complete a questionnaire shown in Table 2. Prior to the questionnaire, the participant had to mark the place where the workshops were held (Nis or Belgrade). We identifies 5 trainees from Belgrade and three trainees from Nis.

Table 2: Trainee satisfaction questionnaire

QUESTIONS	**MEDIAN ± STD**
Q1: How satisfied are you with the work of the instructor during the duration of the course?	4 ± 1.05
Q2: How satisfied are you with the realization of the course?	4 ± 1.09
Q3: How satisfied are you with the level of knowledge that you acquired after completing the course?	4 ± 1.11
Q4: How satisfied are you with the quality of teaching materials?	4 ± 0.99
Q5: How satisfied are you with the organization of teaching materials by the "step by step" rule?	4 ± 1.09
Q6: How much is the weight of the teaching material adequately distributed?	3.5 ± 0.7
Q7: How satisfied are you with the LAMS system?	5 ± 0.99
Q8: How satisfied are you with the use of the LAMS system in the form of tests and other learning activities?	5 ± 0.48
Q9: To what extent are practical examples relevant to the material?	4 ± 0.83
Q10: To what extent is it necessary to add materials to external resources?	3.5 ± 0.83
Q11: If it is necessary to add resources to the teaching materials that would be?	/
Q12: Assess the adequacy of teaching materials in line with the latest IT developments	3.5 ± 0.99
Q13: Assess the quality of the applicability of the acquired knowledge after the course passed?	3 ± 1.11
Q14: How satisfied are you with the quality of the skype consultation?	4 ± 0.93
Q15: How satisfied are you with the quality of mail consultation?	4 ± 1.16
Q16: How satisfied are you with the quality of the workshops held during the course?	5 ± 0.7
Q17: How satisfied are you with the number of classes scheduled for the course during the course?	3 ± 0.86
Q18: Choose the model that you find most suitable for the realization of workshops (once a week, once in two weeks, half and at the end of the course, at the end of the course, other)	/
Q20: How satisfied with the compatibility of exams tasks and teaching material	5 ± 0.7
Q21: Choose the model that you find most appropriate for the course that you attended (a time longer course, a less intensive course or a more intensive course, a shorter period of time)	/
Q22: How satisfied are you with the support of the services of the Metropolitan University?	4 ± 1.4
Q23: Which areas in this course do you consider necessary to further improve:	/
Q24: Here you can write your suggestions, compliments or possible comments about the course	/

The questionnaire used the five-point Likert scale, ranging from the lowest point (1) to the highest (5), and additional essay questions. Questionnaire also provided an option to enter comments in order to give their suggestions and comments in the form of an open-ended question. Questions Q1-3, Q14-17 and Q22 had the goal to give answers to the questions about the satisfaction of the course, instructors, organization and supports from BMU services during the course. Analyzing those results students expressed that are satisfied with instructors (Q1) 4 ± 1.05 (with the median 4.00) and with realization (Q2) and level of knowledge (Q3) that are acquired after completing the course (respectively 4 ± 1.09 and 4 ± 1.11 with the median 4.0). Also, the participants answered that they are satisfied with the method of carrying out Skype consultations (Q14), 4 ± 0.93 (with the median 4.0) and a little less mail consultation (Q15) 4 ± 1.16 (with the median 4.0), which is logical in relation to the type of

course where it is sometimes difficult to explain the problem in writing. Trainees consider the workshops as a very useful especially that it was organized in the traditional way in classrooms (Q16), 5 ± 0.7 (with the median 5.0), but consider that there is insufficient number of traditional classes of workshops that are necessary for an adequate understanding of the material (Q17), 3 ± 0.86 (with the median 3.0).

Some questions has a relatively high standard deviation due to a limited number of trainees, but at this stage we can conclude that trainees are satisfied with quality (4 ± methodology (4 ± 1.09) of learning materials thru Q4 and Q5, but also the trainees opinion is that the difficulty of the teaching material is not adequately distributed, 3.5 ± 0.7 (with the median 3.0), although they think that the examples (Q9) and exams (Q20) are relevant to teaching material 4 ± 0.83 (with the median 4.0). Trainees are absolutely satisfied with BMU eLearning system (Q8) 5 ± 0.99 and they agreed that tests and other learning activities are of the great help in learning process (Q9) 5 ± 0.48 (both with the median 5.0).

Lower satisfaction of the students is observed in the assessment of the conformity of learning materials with IT trends (Q12) 3.5 ± 0.99 and the applicability of the acquired knowledge after the course (Q13) 3 ± 1.11. We believe that such results may be due to insufficient practice of the participants and overloading information that needs to be channeled through practical work. Certainly, BMU has the task of further improving teaching materials in order to increase the adequacy.

Students responded positively to “Programming in Java” short cycle program even through their comments thru Q11, Q18, Q221, Q23 and Q24. Students considered the course to be useful and interesting:

“Program is good”,

“It's a good and interesting course”,

“The program is very useful and provides a lot of practical knowledge for future employment.”

Additional comments and suggestions points on other questions of an essay questionnaire are generally similar and we can conclude that it is necessary to improve:

“Everything is good, but there is a lack of traditional work in the classroom with instructors”,

“More teamwork is needed”,

“The course needs to be slower and less intense.”

Comment such as: ”Links to online resources would be helpful” indicates that learners also consider that additional online resources would be helpful if they were linked to LO.

Conclusions that can be made for the improvements of short cycle “Programming in Java” program from given results are the following:

- Workshops must be organized more often and should be longer
- It is important to provide additional resources to LOs or assigned problems, such as Internet resources and
- The extent of the course and its intensity should be re-examined.

5. CONCLUSION

This work deals with evaluation of short cycle program "Programming in Java" implemented as a pilot program of PT&SCHE project and aims to provide one critical source of information in the order for the future improvement of courses, curriculum, and instructor's pedagogic efforts. Today, everyone can find all possible information on the Internet. However, if the learning process is routed and controlled by an appropriate technology and methodology as implemented in the short program "Programming in Java" realized as pilot program of PT&SCHE project on BMU, then the learning process is much faster, easier and more effective as shown in conducted evaluation. Therefore, future analyzes and improvements will be directed at what is considered by trainees as a lack in the current implementation of program, such as the intensity of the course with the increasing of the work with instructors.

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