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A Comprehensive Approach for Monitoring Student Satisfaction in Blended Learning Courses

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***Abstract*:** *Due to the great importance of student satisfaction with educational services, many HEIs conduct annual surveys. Analyzing the results of such surveys, tracking trends, and comparing the evaluation results to help governing bodies make data-driven decisions to take measures to improve the quality of courses is time-consuming and requires a lot of manual work. As a solution to the problem, this paper proposes a comprehensive approach to monitoring student satisfaction with the quality of blended learning courses. The developed software tool analyzes results and enables users with different roles to generate reports with aggregated results at different levels, allowing them to make informed decisions and take measures to ensure a higher quality of courses. The generated reports during the pilot experiments proved the tool's applicability. This tool can be implemented in any HEI, regardless of the software systems used.*

***Keywords*:** *Blended learning, Quality, Student satisfaction, Monitoring, Software tool, Decision making, HEI leadership.*

1. Introduction

To improve the quality of offered educational services and increase student satisfaction, modern universities are searching continuously for ways to effectively implement new technologies in all their activities [1-2]. The digital transformation process is long, but this process can bring quality changes in the organization, planning, and management of Higher Education Institutions (HEIs) [3]. To be more attractive to their students, HEIs make continuous efforts to increase the quality of the services offered and strive to meet and exceed the expectations of their students by providing them with more online administrative services and greater control over content and time for learning based on their individual needs [4]. As a result, many HEIs have incorporated various forms of distance and online learning [5]. In some HEIs, adopting distance learning forms raises concerns about teacher-student interactions and interactions among peers, students' academic achievements, and the overall quality of education [6]. Since blended learning allows the combination of formal and online learning, many HEI leaders perceive it as a suitable alternative to distance learning [7], a promising approach for student satisfaction, and a preferred learning form [5, 8-14].

To ensure a competitive advantage, HEIs should implement new technologies and study student satisfaction with the quality of offered services. The periodic student satisfaction surveys with blended learning help HEIs achieve a high learning quality. According to many researchers, students' satisfaction is critical in measuring the effectiveness and quality of blended learning and an essential requirement for its successful implementation [3, 6, 15-19]. Student satisfaction determines their motivation and helps them to achieve higher learning results and commitment to a learning program [1, 3, 5, 17, 20]. In addition, satisfied students tend to provide a free promotion source for the university and recommend it to future students [3]. The results of monitoring student satisfaction are essential for effective HEI management. It helps HEI leaders pinpoint strengths and weaknesses of educational processes, courses, staff and teaching quality, curricula, learning environment, and policies and identify areas for improvement [12, 20-24].

The question of student satisfaction with blended learning excites researchers worldwide who research what factors influence student satisfaction with the quality of blended learning and eventually may lead to their improvement in performance [3, 15-18, 25-27]. Currently, there is no single accepted definition of student satisfaction. In their attempts to define student satisfaction, some researchers focus on achievements and success in learning [28], while others emphasize learning experiences and students' feelings and attitudes during the learning process [29]. In addition, blended learning can be viewed from multiple perspectives, incl. course organization, delivery, conditions, etc., which complicates the issue of student satisfaction study [5]. Understanding the key factors determining student satisfaction allows educators to improve course quality and, in the future, offer students hybrid courses with a more spectacular design [18, 30].

Due to the great importance of student satisfaction, many HEIs conduct annual surveys of student satisfaction with the quality of educational services using validated and reliable instruments [6]. Descriptive analyses, such as frequencies or comparisons of means, and qualitative tools, such as focus groups or personal interviews, are often used methods for result analyses [31].

Few studies have addressed the issues of monitoring the results from conducted studies [1, 32]. To ensure the effectiveness of the implemented blended learning courses, it is essential that the HEI management not only conducts periodic surveys, the results of which are made public and used to improve the quality of the blended courses but also set up a structure for central and longitudinal data collection for monitoring and evaluation purposes [1]. The time series data provide a powerful lens into the HEI's strategies, initiatives, and actions that worked well and those needing further effort or adjustment [32]. Analyzing the results of such studies, tracking trends, and comparing the results of the evaluation of different online courses to help governing bodies make informed, specific, and consistent, data-based decisions to take measures to improve the quality of online courses is time-consuming and requires a lot of manual work after each assessment.

As a solution to the problem, this paper proposes a comprehensive approach to monitoring student satisfaction with the quality of blended learning courses and a corresponding software tool for analyzing the results of student satisfaction surveys

developed for the needs of HEI leaders. Section 2 reviews factors influencing student satisfaction with the quality of e-Learning and previous research in the field and presents the developed authors' questionnaire and data collection process. In Section 3, the authors present the developed tool. Section 4 describes experiments conducted to assess the quality of seven online courses and analyze the results using the developed tool. The Conclusion section outlines the contributions, limitations of the paper, and the authors' plans for future research in the field.

2. Materials and methods

In the current research, we consider blended learning as a combination of the characteristics of traditional learning and electronic learning (e-Learning) and more precisely as an integration of the face-to-face teaching and learning process with the online self-learning process. Based on this understanding the students participating in traditional face-to-face courses are using corresponding e-Learning courses (e-courses) hosted in a learning management system for self-training/learning. These e-courses contain theoretical study materials, exercise and (self) assessment materials, guidelines for orientation, supporting facilities, and means of communication with teachers and classmates.

Therefore, the method used in the research for measuring the quality of blended learning courses evaluates the students' satisfaction from the point of view of the course content, organization of training, means of communication and support during the learning process, and assessment procedures for evaluation of students' knowledge and skills. The method could be partially used to evaluate courses conducted entirely in distance form.

Proposing a comprehensive approach to monitoring student satisfaction with the quality of blended learning courses requires investigating factors that influence student satisfaction, developing a questionnaire, and designing and developing a software tool to do an analysis of survey results and to facilitate HEI leaders in making decisions to improve the quality of education.

2.1. Investigating factors

In many studies, researchers have identified course content and structure [27, 33-42], design, and ease of use [43] as significant factors in student satisfaction with blended learning. Completeness and diversity [22-23, 40-41, 44-47], the relevance of learning materials, and the applicability of acquired knowledge and skills in practice [48-50] are essential for student motivation and success. Supporting learning materials with relevant examples [25] and informational materials about the training conducted [51] contribute to student satisfaction.

The organization and management of learning and the learning process directly impact on student satisfaction [5-6, 15-16, 43, 51-52], incl. students' awareness of learning organization, assessment, and the curriculum [3, 15, 51]. Students are more satisfied if a blended course provides opportunities to personalize learning [19, 40, 45-46] and effective ways to present and deliver learning content [45].

A significant factor in student satisfaction studied by experts is student evaluation [27, 39-40, 44, 53] and the clarity of assessment tasks [40].

Many researchers have identified communication and opportunities to connect with teachers and peers as crucial predictors of student satisfaction [40-41, 43]. A powerful catalyst of student satisfaction is the provided interaction opportunities [37-38, 51, 54-57], the conditions for student teamwork, and a created digital learning community with positive and engaging interactions [17, 27, 38, 58].

The teacher also plays a vital role in student satisfaction [26-27, 41, 51, 59], providing his (her) support [33-34, 43, 57, 60] and timely feedback [6, 22-23].

Some studies have identified the availability of modern IT infrastructure and technologies [15, 33, 41, 51, 61] and facilities [27, 43] as predictors of students' satisfaction. It is significant for students to have constant access to an easy-to-use learning platform with rich functionality [6, 59, 62], providing self-efficacy [1-2, 63] and receiving adequate and timely administrative and technical support when encountering difficulties in working with the systems [1, 26, 34, 37, 53, 64].

Other less researched factors are perceived quality [1, 15, 63], perceived value [15, 19], online learning acceptance [26, 59], prior experience [26, 59], performance expectations [5, 63], behaviors control [63], subjective norms [63] and perceived enjoyment [63]. A few researched factors are the authentication options and preventions against exam cheating and plagiarism used during the training.

2.2. Questionnaire for assessing student satisfaction in blended learning courses

Based on the reviews of determinants for students' satisfaction from blended learning courses and gaps in the literature, the authors develop a questionnaire for measuring the quality of blended learning courses from a student perspective. It contains 31 items divided into 4 areas:

- Course content and design – 9 items;
- Organization, preparation, and conduct of training – 11 items;
- Communication and support in the learning process – 7 items;
- Evaluation – 4 items.

Fig. 1 presents the assessed characteristics of the blended learning course in each area.

Experts in distance learning quality assurance and survey conducting evaluated the initial version of the questionnaire. Based on their feedback, we revised the questionnaire by removing 10 and updating five questions. The reliability and validity of the questionnaire developed have been verified by conducting a pilot evaluation of an Object Oriented Programming course. The pilot evaluation allowed us to conclude that the questions in the developed questionnaire have internal consistency, and the assessment results can be used for performing quality analysis of the university's blended learning courses.

The final version of the questionnaire is added as a template to the learning management system used at the university – Moodle. Once added as a template, it can be included and used to assess the quality of any course hosted on Moodle. All questions are mandatory, and students can answer using a 5-point scale – with grades from 2 to 6.

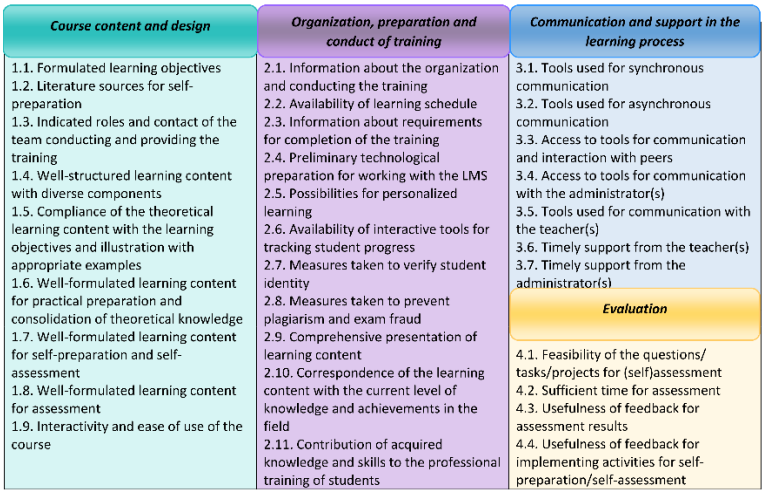


Fig. 1. The evaluated characteristics of the blended learning course

3. Software tool

The development of a tool for monitoring the quality of blended learning courses goes through five steps:

Step 1. Identification of interested stakeholders;

Step 2. Designing a set of report templates for monitoring the quality of blended learning courses;

Step 3. Determining access to the tool's functionalities;

Step 4. Proposing software architecture and selecting tools for implementation;

Step 5. Software tool implementation.

In the first step, the needs of stakeholder groups have been determined. Internal stakeholders who will use the course quality monitoring reports generated by the tool to make informed decisions to improve course quality are Teachers, Dean Leadership, Rector Leadership, and the Distance Learning Centre team. To provide access to aggregated information that allows external stakeholders to generate reports with evaluation data for the courses, the needs of external stakeholders have also been taken into account.

Teachers are interested in receiving feedback from their students about the quality of the blended learning courses they have developed and the overall process of organizing and delivering training. Detailed results from annual course evaluations can help teachers identify areas where they need to improve their courses and track whether the changes made have led to higher grades in the next academic year.

The Dean leadership of the faculties is interested in the summary results of the evaluation of the courses, which are part of the curricula of the study programs offered by the faculty they manage. It is vital for them to track trends in course evaluations at the study programs and professional field and to make informed decisions both to take measures to improve the quality of blended learning courses and to stimulate teachers whose learning courses are rated highly by the students. To be convinced that the grades have been calculated based on completed questionnaires

filled out by a sufficient number of students; the Dean's leadership is interested in tracking the activity of the students in assessing the quality of the blended learning courses offered by the faculty.

For the Rector's leadership, and in particular the vice-rector for educational activities, aggregated data are of interest, which allows them to track the calculated evaluations of the blended training courses at the study program and professional field levels. Based on the results of several consecutive years, they can make informed decisions and take measures to improve the quality of courses. Again, for the decisions to be made based on a sufficient number of evaluations by students, it must be possible to track the activity of the students when filling out questionnaires. Other aggregated data that may support the Rector's leadership to make decisions for stimulating faculty staff members are calculated grade point averages and a compiled ranking of the university's top ten courses.

The Distance Learning Centre is also directly interested in the quality of the blended learning courses. Its staff needs to track assessment results at granular and more aggregated levels. Based on the evaluation results, they can track trends and make decisions to support teachers, e.g., by announcing training for low-performing areas.

The public is interested in summarized results of evaluations of courses in a study program and a professional field.

Based on the analysis of the stakeholders and their needs, a set of report templates for monitoring the quality of blended courses is proposed that stakeholder groups can use to generate reports with the results of conducted course evaluations. Table 1 presents the designed templates at the Course, Study program, Professional field, and University levels, consisting of 14 templates in total (5 – at the Course level, 3 – at the Study program level, 3 – at the Professional field level, and 5 – at the University level).

Table 1. A set of report templates

Template	Course level	Study program level	Professional field level	University level
Summary results of course quality evaluation (by evaluated characteristics)	+			
Summary results of course quality evaluation (by evaluated areas)	+			
Detailed results of course quality evaluation (by evaluated characteristics)	+			
Summary results of course quality evaluation (for a period)	+	+	+	+
Student activity in course quality evaluation (for a period)	+	+	+	+
Number of courses with conducted quality evaluations		+	+	
Course ranking (top 10 highest/lowest rated courses)				+
Summary results of the quality evaluation of blended learning courses in professional fields (for a period)				+
Summary results of the quality evaluation of blended learning courses in study programs (for a period)				+

Fig. 2 presents the user roles and access to the designed report templates by which a user can generate reports with actual data from a blended course learning evaluation.

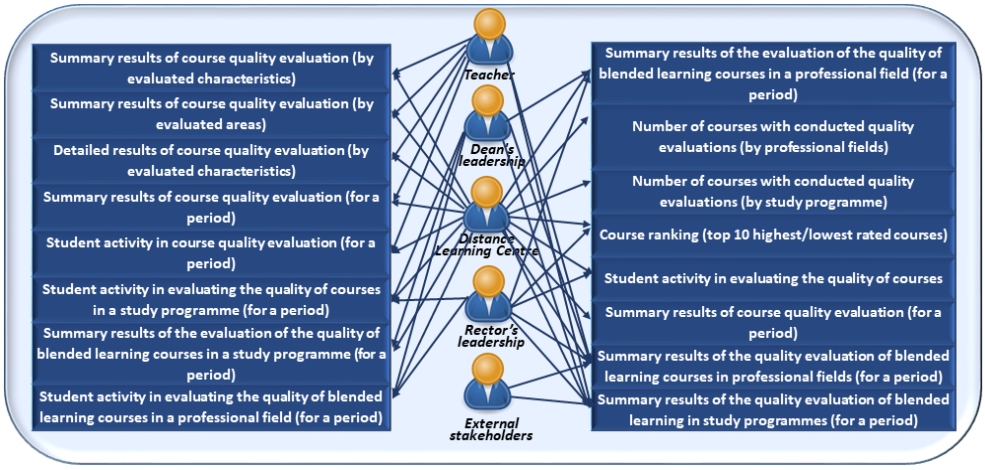


Fig. 2. Roles and access to student satisfaction monitoring reports

Table 2. Set of calculated and visualized data

Template	Data
Summary results of course quality evaluation (by evaluated characteristics)	Calculated average grades by evaluating course characteristics
Summary results of course quality evaluation (by evaluated areas)	Calculated average grades by evaluating areas
Detailed results of course quality evaluation (by evaluated characteristics)	Number of grades 2-6 received for each evaluating course characteristic and area
Summary results of course quality evaluation (for a period)	Calculated average grades for the previous 5 years for each course characteristic and area
Student activity in course quality evaluation (for a period)	Number of completed questionnaires (% of students trained) for a 5-year period
Student activity in evaluating the quality of courses in a study program (for a period)	Number of completed questionnaires (% of students enrolled) to assess the quality of courses over a 5-year period
Summary results of the evaluation of the quality of blended learning courses in a study program (for a period)	Calculated course average grades for the previous 5 years
Student activity in evaluating the quality of blended learning courses in a professional field (for a period)	Calculated course average grades for the previous 5 years
Summary results of the evaluation of the quality of blended learning courses in a professional field (for a period)	Calculated course average grades for the previous 5 years
Number of courses with conducted quality evaluations (by professional fields)	Number of courses with conducted quality assessment in each professional field
Number of courses with conducted quality evaluations (by study program)	Number of courses with conducted quality assessment in each study program
Course ranking (top 10 highest/lowest rated courses)	Calculated average grades of courses
Student activity in evaluating the quality of courses	Number of completed questionnaires and % of learners who completed the questionnaire for each course in the previous 5 years
Summary results of course quality evaluation (for a period)	Calculated average grades of all courses for the previous 5 years
Summary results of the quality evaluation of blended learning courses in professional fields (for a period)	Calculated average grades of courses in all professional fields for the previous 5 years
Summary results of the quality evaluation of blended learning in study programs (for a period)	Calculated average grades of courses in all study programs for the previous 5 years

The design of report templates for monitoring student satisfaction with the quality of the courses offered also requires defining a set of data to be visualized in the documents generated by them. All templates include a certain set of elements

whose values must be retrieved from the data source of system in which the evaluation is performed stores the data. The *Course level* reports present information about the name of the evaluated course, the instructors, and the year/evaluation period. The *Study program/Professional field* levels reports contain information on the name of the study program/professional field and the year/evaluation period. The *University level* reports contain information about the evaluation period. The rest of the data requires calculations of the results from the conducted course quality evaluation based on the students' ratings and is specific to each designed template. Table 2 presents a list of data for each designed report template.

Fig. 2 shows that users with different roles should be able to generate course quality monitoring reports on templates with the same names. Since the data shown must vary according to the stakeholder group, it is necessary to design and develop different versions of the templates, differing in their parameters. This fact requires the setting of Course level parameters (*Course parameter*), Professional field level (*Professional field parameter*), and Study program level (*Study program parameter*). All report templates for course quality monitoring at these three levels also have the same additional parameter – *Year*, which specifies the year when the course evaluation has been performed. Because the university-level report templates visualize aggregated data, there are no parameters on this level. An exception is the "Course Ranking (Top 10 Courses with Highest/Lowest Grade)" template, which displays calculated average grades of courses in a specific academic year, which requires entering a value for the *Year* parameter.

In the next step, after a detailed study of the software solutions on the labor market offered for extraction data from various sources, data analysis, and visualization, we have selected solutions for the development of the tool for monitoring students' satisfaction with the quality of the blended learning course (PUStudSatBL) offered at the university. It will be developed by integrating the existing software JasperReport Server and JasperSoft Studio (proposed by TIBCO Software, **https://www.tibco.com/**) and an author client application. The reasons for the choice are:

– the rich possibilities of these tools for generating documents according to a pre-developed template;

– the fact that they have free-to-use Community versions; their wide application in various fields (e.g., utilities, professional services, oil and chemicals, government, manufacturing);

– last but not least, in recent years these tools have been widely used in PU and are integrated with the candidate student management systems and the university portals for student and faculty staff.

JasperSoft Studio offers rich capabilities for designing document templates with various elements that can be filled out with data extracted from different data sources (relational databases, sources of big data, etc.). On the other hand, JasperReport Server allows organizing structured repositories for storing the document templates developed with JasperSoft Studio and documents generated through them, exporting the documents in the format preferred by the user, and it can be integrated with software applications through web services.

PUStudSatBL has a 3-layer architecture (Fig. 3) with Presentation, Application, and Data layers. At the Presentation level, the client application is located, which allows users, after authorization in the tool, to create reports for monitoring the satisfaction of students in blended learning courses according to a selected template (accessible for their role), view the report on the screen and, if desired, download it to a chosen device. This layer also hosts the JasperReports Server PHP client (**https://community.jaspersoft.com/wiki/php-client-sample-code**), which allows the tool to be integrated with the JasperReports Server REST API. The core functionality of the Application layers is implemented through JasperSoft Studio's report template design tool. Using JasperSoft Studio, 16 report templates (see Table 2) have been developed for the needs of users with roles Teacher, Dean's leadership, Rector's leadership, Distance Learning Center, and External Stakeholders (see Fig. 2). Elements, whose values are to be completed are received after executions of the following request to the database of the system in which the courses' evaluations have been performed and the subsequent calculations. This development requires a detailed analysis of the system's database (in the case of Moodle database) located in the Data layer. To develop the templates, all tables that store information about users and Feedback activity (used for organizing quality assessment) and the relationships between them have been studied in detail. Tables for storing data on developed courses (course), storing data on study programs and professional fields (user_info_data), assigned roles of users in the system (role assignments), added feedback (feedback), completed questionnaires for evaluation (feedback_completed), added questions in questionnaires (feedback_item), given assessments (feedback_value), have been examined. All developed templates are stored in the JasperReports Server.

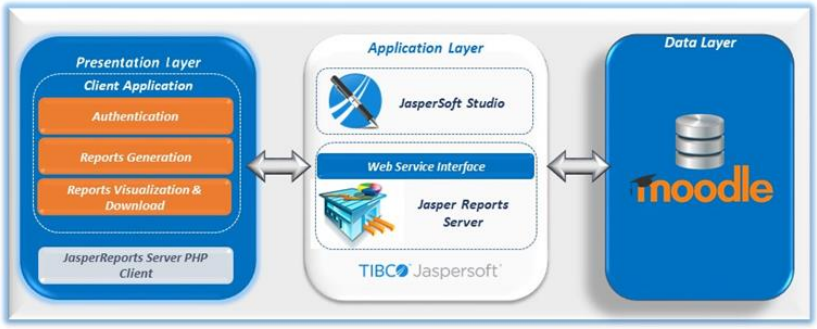


Fig. 3. PUStudSatBL Architecture

JasperReports Server acts as a middleware between the three layers in the application architecture. After a user logs in, the PUStudSatBL client application starts a JasperReports Server REST service. The web service interface responds to HTTP requests from the client application. It returns a list of templates on which the user is allowed to generate reports and their corresponding parameters. The possible parameter input values are retrieved from the database of the client application, thus excluding the possibility of inputting incorrect parameter values and limiting access to evaluation reports. For example, the user with the role Teacher can choose a

corresponding value for the Course parameter from a drop-down list that contains only the names of the disciplines he/she is teaching and the Dean of a faculty – a value for the Study program parameter from a list of study programs offered in the faculty he/she leads. After selecting a parameter value, PUStudSatBL starts a REST service to run the chosen template and generate a report. The web service interface responds to the client application's request, the JasperReport Server accesses the data source and retrieves the data needed to populate the template, then fills out the template with actual data (obtained directly from the database or through calculations) and generates a report that it returns as a response to the request made by PUStudSatBL. PUStudSatBL visualizes the returned report. The tool can start a REST service to download the generated report in PDF format at the user's request.

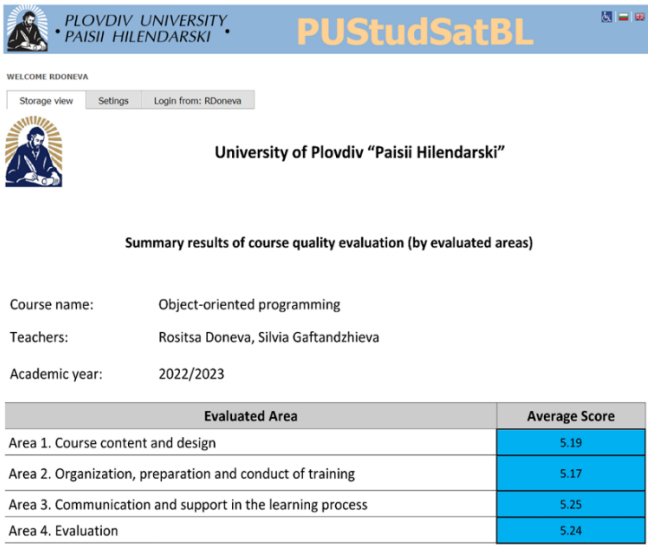
4. Experiments

PUStudSatBL has been tested for quality assessment of seven blended learning courses:

- "Fundamentals of programming", studied by students in Information and Computer Engineering, Telecommunications and Information Systems, Technologies in Telecommunications;
- "Object-oriented programming", studied by students in Information and Computer Engineering, Telecommunication and Information Systems, and Bioengineering;
- "Ecological chemistry and environmental protection", studied by students in Computational Chemistry, Chemistry, Chemistry, and Marketing;
- "Information technologies", studied by students in Mathematics, Applied Mathematics;
- "Project Management", studied by students in Informatics;
- "History of Music part I", studied by students in Jazz and pop performing arts;
- "History of Music part II", studied by students in Jazz and pop performance art.

During the pilot testing of the tool, users with different roles generated reports to monitor student satisfaction with the quality of the seven learning courses.

Fig. 4 shows a quality assessment report generated by a user with the *Teacher* role (author of the assessed course). The report contains summarized results of a quality assessment of the "Object Oriented Programming" course conducted during the 2022/2023 academic year. The calculated average grades of the evaluated areas show that, in general, students are satisfied with the quality of the study materials, the organization and the training conducted. They give the highest average grade (5.25 out of a max score of 6) to Area 3. Communication and support in the learning process, and the lowest (5.17 out of a max score of 6) to Area 2. Organization, preparation and conduct of training. These results show the teacher that, despite the high grades of the course, he/she can take some measures to increase its quality.



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Summary results of course quality evaluation (by evaluated areas)

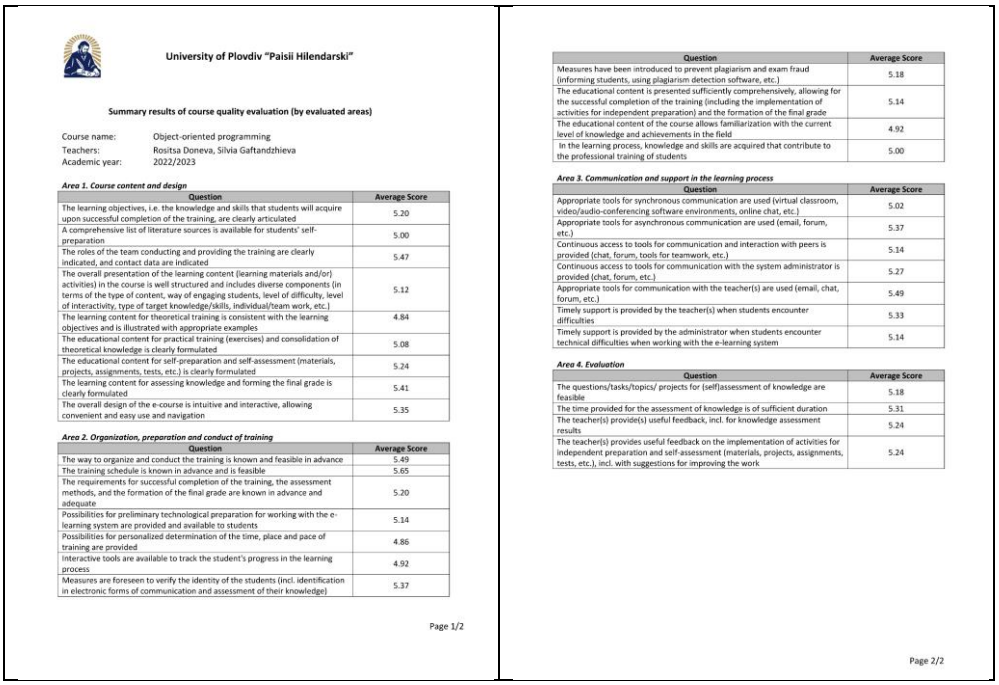
Course name: Object-oriented programming

Teachers: Rositsa Doneva, Silvia Gaftandzhieva

Academic year: 2022/2023

Evaluated Area	Average Score
Area 1. Course content and design	5.19
Area 2. Organization, preparation and conduct of training	5.17
Area 3. Communication and support in the learning process	5.25
Area 4. Evaluation	5.24

Fig. 4. Summary results of course quality evaluation



University of Plovdiv "Paisii Hilendarski"

Summary results of course quality evaluation (by evaluated areas)

Course name: Object-oriented programming
Teachers: Rositsa Doneva, Silvia Gaftandzhieva
Academic year: 2022/2023

Area 1. Course content and design

Question	Average Score
The learning objectives, i.e. the knowledge and skills that students will acquire upon successful completion of the training, are clearly articulated	5.20
A comprehensive list of literature sources is available for students' self-preparation	5.00
The roles of the team conducting and providing the training are clearly indicated, and contact data are indicated	5.47
The overall presentation of the learning content (learning materials and/or) activities) in the course is well structured and includes diverse components (in terms of the type of content, way of engaging students, level of difficulty, level of interactivity, type of target knowledge/skills, individual/team work, etc.)	5.12
The learning content for theoretical training is consistent with the learning objectives and is illustrated with appropriate examples	4.84
The educational content for practical training (exercises) and consolidation of theoretical knowledge is clearly formulated	5.08
The educational content for self-preparation and self-assessment (materials, projects, assignments, tests, etc.) is clearly formulated	5.24
The learning content for assessing knowledge and forming the final grade is clearly formulated	5.41
The overall design of the e-course is intuitive and interactive, allowing convenient and easy use and navigation	5.35

Area 2. Organization, preparation and conduct of training

Question	Average Score
The way to organize and conduct the training is known and feasible in advance	5.49
The training schedule is known in advance and is feasible	5.65
The requirements for successful completion of the training, the assessment methods, and the formation of the final grade are known in advance and adequate	5.20
Possibilities for preliminary technological preparation for working with the e-learning system are provided and available to students	5.14
Possibilities for personalized determination of the time, place and pace of training are provided	4.86
Interactive tools are available to track the student's progress in the learning process	4.92
Measures are foreseen to verify the identity of the students (incl. identification in electronic forms of communication and assessment of their knowledge)	5.37

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Question	Average Score
Measures have been introduced to prevent plagiarism and exam fraud (informing students, using plagiarism detection software, etc.)	5.18
The educational content is presented sufficiently comprehensively, allowing for the successful completion of the training (including the implementation of activities for independent preparation) and the formation of the final grade	5.14
The educational content of the course allows familiarization with the current level of knowledge and achievements in the field	4.92
In the learning process, knowledge and skills are acquired that contribute to the professional training of students	5.00

Area 3. Communication and support in the learning process

Question	Average Score
Appropriate tools for synchronous communication are used (virtual classroom, video/audio-conferencing software environments, online chat, etc.)	5.02
Appropriate tools for asynchronous communication are used (email, forum, etc.)	5.37
Continuous access to tools for communication and interaction with peers is provided (chat, forum, tools for teamwork, etc.)	5.14
Continuous access to tools for communication with the system administrator is provided (chat, forum, etc.)	5.27
Appropriate tools for communication with the teacher(s) are used (email, chat, forum, etc.)	5.49
Timely support is provided by the teacher(s) when students encounter difficulties	5.33
Timely support is provided by the administrator when students encounter technical difficulties when working with the e-learning system	5.14

Area 4. Evaluation

Question	Average Score
The questions/tasks/topics/ projects for (self)assessment of knowledge are feasible	5.18
The time provided for the assessment of knowledge is of sufficient duration	5.31
The teacher(s) provide(s) useful feedback, incl. for knowledge assessment results	5.24
The teacher(s) provides useful feedback on the implementation of activities for independent preparation and self-assessment (materials, projects, assignments, tests, etc.), incl. with suggestions for improving the work	5.24

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Fig. 5. Summary results of course quality evaluation (by evaluated characteristics)

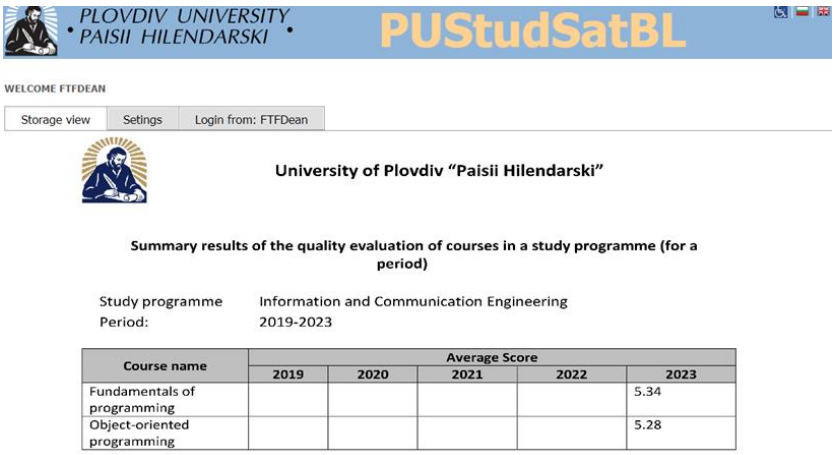
If the teacher should do a more detailed analysis of areas where students feel that some changes to improve the course quality are needed, s(he) can generate and download a more detailed report (Fig. 5). The report *Summary results of course quality evaluation* (*by evaluated characteristics*) generated through the tool presents the calculated average grades for each assessed course characteristic. For example, the results for course characteristics in the area with the lowest average for the

"Object-Oriented Programming" course indicate that to increase student satisfaction, teacher(s) need to improve the opportunities offered for personalized learning (average score 4.86), tracking student progress and update course content to acquaint students with more current advances in the field (average score 4.92). In this area, the students gave high average scores to the preliminary information about the study schedule (average score 5.65) and how the training is organized and conducted (average score 5.49).

When a more in-depth analysis is needed, the teacher can also generate a report presenting the number/% of students who scored 2, 3, 4, 5 and 6 in each evaluated course characteristic.

The Distance Learning Centre team can generate similar reports for each course in the e-Learning system and analyse the aggregated and detailed results to support course authors and offer relevant training.

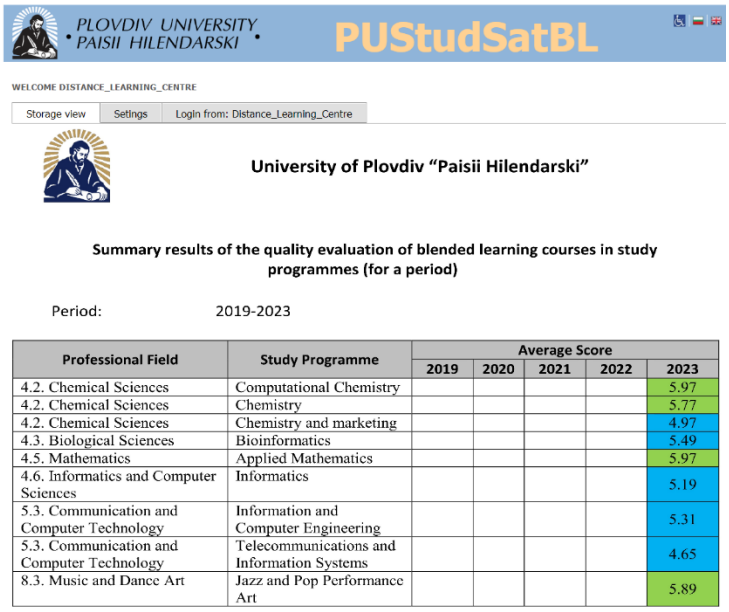
Fig. 6 presents the report *Summary results of the quality assessment of courses in a study program* (*for a period*) generated by a user with the role of *Dean*. The PUStudSatBL tool allows each Dean of a faculty/Director of a branch to generate reports with the summary results from evaluating courses in a selected study program taught in the faculty/branch (s)he leads. The summary report shows the calculated average grades of all courses in the chosen study program over the previous five years. The results allow faculty/branch leaders to track trends, make informed, data-driven decisions, and take measures to improve the quality of courses with low average grades over the period or significant declines in results in consecutive years. Such solutions would be stimulating, for example, teachers to participate in training, scientific conferences and round tables dedicated to different forms of online learning. Since the developed tool is in an experimental phase, the report presented in Figure 6 contains only results from 2023. The calculated average grades show that the courses for the study program Information and Computer Engineering from the Faculty of Physics and Engineering Technologies are of high quality – the students from this study program scored a 5.34 on the Fundamentals of Programming course and a 5.28 on the Object-Oriented Programming course.


PLOVDIV UNIVERSITY PAISII HILENDARSKI
PUStudSatBL
WELCOME FTFDEAN
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University of Plovdiv "Paisii Hilendarski"
Summary results of the quality evaluation of courses in a study programme (for a period)
Study programme: Information and Communication Engineering
Period: 2019-2023

Course name	Average Score				
	2019	2020	2021	2022	2023
Fundamentals of programming					5.34
Object-oriented programming					5.28

Fig. 6. Summary results of the quality assessment of courses in a study program (for a period)

Fig. 7 shows a report *Summary results of the quality evaluation of blended learning in study programs* (*for a period*) generated by a user with the *Distance Learning Centre* role.



Professional Field	Study Programme	Average Score				
		2019	2020	2021	2022	2023
4.2. Chemical Sciences	Computational Chemistry					5.97
4.2. Chemical Sciences	Chemistry					5.77
4.2. Chemical Sciences	Chemistry and marketing					4.97
4.3. Biological Sciences	Bioinformatics					5.49
4.5. Mathematics	Applied Mathematics					5.97
4.6. Informatics and Computer Sciences	Informatics					5.19
5.3. Communication and Computer Technology	Information and Computer Engineering					5.31
5.3. Communication and Computer Technology	Telecommunications and Information Systems					4.65
8.3. Music and Dance Art	Jazz and Pop Performance Art					5.89

Fig. 7. Summary results of the quality evaluation of blended learning in study programs (for a period)

All stakeholders (incl. external stakeholder groups not registered in the tool) can also request to run this report. The report visualizes calculated average grades of courses developed for the needs of students in study programs from all accredited professional fields offered at the university over the last five years. The data in the report allows all stakeholders to track assessment trends over the period, identify study programs with the lowest/highest student-rated courses, and gain insight into the overall quality of the blended learning courses offered at the university. Based on this data, internal stakeholder groups can make decisions to take measures to improve the quality of blended learning courses in low-performing study programs. The results are also helpful for various external stakeholder groups. For example, candidate students for whom the quality of the blended learning courses offered in the desired study program is vital can make informed decisions about applying to the university. The report shows summary results from the quality evaluation of blended learning courses for students in 10 study programs conducted in 2023. Due to the conditional formatting assumed when developing the report template, the background of the cells with calculated course average marks in the evaluated study programs is different – Excellent grades have a green background (above 5.50), Very good (between 4.50 and 5.49) have a blue background. It is clear from the summary results that the blended learning courses offered at the university are high quality. Students in four study programs (Computational Chemistry, Chemistry, Applied Mathematics, and Jazz and Pop Performance Art) are more than satisfied with the blended learning courses and give Excellent grades, as the results of the courses in Computational

Chemistry and Applied Mathematics study programs are being very close to the maximum possible score (6.00). The blended learning courses in five study programs are rated Very Good, with the rating of the courses in the Bioinformatics study program being very close to Excellent. The lowest average score has the blended learning courses for students in the Telecommunications and Information Systems study program, which shows that there is a need to take measures to improve the satisfaction of the students trained in this study program.

5. Conclusion

The PUStudSatBL tool retrieves and analyzes results from surveys conducted to assess the quality of blended learning courses from the student's perspective. The tool enables users with different roles to generate reports with aggregated results at different levels, which allows teachers, the Distance Learning Centre team, and governing bodies of the University of Plovdiv to make informed decisions and take measures to ensure a higher quality of courses.

The tool is provided for testing at the University of Plovdiv. During the tool pilot testing, users with different roles have generated reports to assess the quality of seven blended learning courses offered to students from 10 study programs. The generated reports prove the applicability of PUStudSatBL for monitoring student satisfaction with the quality of blended learning courses and guiding informed decisions to improve course quality.

A limitation of the current study is that the tool is tested to evaluate the training courses. Another limitation of this study is that, since the developed questionnaire is used firstly at the end of the 2022/2023 academic year, there is currently no data collected from surveys conducted in previous years, which would allow users to track the trends in the assessment and to evaluate the effectiveness of the measures taken to quality improvement. In the next academic year, experiments for course quality evaluation in more study programs and monitoring trends in course ratings will be conducted. Another limitation of the present study is that the assessment is based on subjective opinions of students. The tool relies only on the larger number of completed questionnaires to reduce subjectivity and obtain more objective results. To overcome subjectivity in grading by the students when answering the questionnaire, in future versions of the question card, rubrics will be added to orient students to which course requirements, and which grade corresponds. In addition, in future versions, when calculating the course score, both student opinion and their activity in the blended learning course during the training will be considered.

Based on the feedback received from the experimental testing of the tool from representatives of various stakeholder groups, the tool's functions will be expanded. Plans for future improvement include the design and the development of templates enabling users to generate reports with summarized results on a Faculty level and integrated with other data sources to extract data from other systems used in the university suitable for organizing and conducting student satisfaction surveys.

The PUStudSatBL tool can be modified to assess the quality of any course type, including distance learning courses. For this purpose, a new questionnaire needs to

be modeled, and the report templates modified to extract data for the completed questionnaires.

The application being developed can be implemented in any university, regardless of the software systems used. For this purpose, templates of all reports must be updated to retrieve data from the software system for surveys used at the university.

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