Towards Automated Evaluation of the Quality of Educational Services in HEIs

Silvia Gaftandzhieva[1], Rositsa Doneva[2], Mariya Zhekova[3], George Pashev[4]
University of Plovdiv "Paisii Hilendarski", Plovdiv, Bulgaria[1, 2, 4]
University of Food Technology, Plovdiv, Bulgaria[3]

Abstract—**The provision of educational services with high quality is a matter of concern to all stakeholders in higher education (academic staff, administration, students, etc.). According to many researchers, student satisfaction is an indicator of service quality in higher education institutions (HEIs), and evaluating the quality of educational and administrative services from students is an effective tool for improving the quality of HEIs. To ensure a competitive benefit over other educational institutions, HEIs leadership should take measures leading to improved student feedback on the quality of the provided administrative and education services, seek ways to exceed student expectations and provide high-quality services. Due to the great importance of the opinion of students on the quality of the services offered, many HEIs develop and use tools to assess student satisfaction with the quality of the services in the HEI. Little researched in the literature is the issue regarding the need to develop tools for HEIs leadership allowing survey results analysis, tracking trends over the years and comparing HEIs results. Based on a detailed analysis of developed questionnaires for evaluating the quality of services, this paper explores the possibilities of automation of the overall process for conducting questionnaire surveys of student's satisfaction with the quality of services. As a result, a software prototype of a tool to automate the entire process for assessing student satisfaction is proposed - from questionnaire modelling, survey organizing and conducting to the analysis of the collected data. The developed tool allows governing bodies in HEIs to make informed decisions to improve the quality of services and to compare the results with those of competing universities.**

Keywords—Quality assurance; higher education; educational services; administrative services; data analysis

I. INTRODUCTION

Quality assurance is a developmental process in the European Higher Education Area (EHEA). Standards, criteria and performance indicators are the starting point in the quality evaluation process at a given time. The implemented quality assurance methodologies of evaluation agencies assess whether or not HEI achieve threshold standards, focus on identifying or promoting HEIs excellence and formulate recommendations for quality improvement. In turn, excellence models set goals for institutions to exceed minimum expectations [1].

Due to the global growth of the higher education sector, HEIs are facing significant challenges to undertake sustainability initiatives in teaching, research and development and administrative services. High competition forces HEIs to review their policies, procedures and marketing guidelines to ensure that they provide quality educational services and globally recognized education [2-3].

HEIs aim to produce services related to teaching, research and public service [4], divided into two main groups-administrative and educational services. The primary purpose of the administration in the HEI is to enable the performance of the main functions by providing support, integration, coordination, supervision, service of the learning processes, scientific research and public services. Regardless of differences in the specific nature of administrative work, all forms of administrative work can be considered a service. When considering administrative work as a service provision, there are two main groups of users: internal (academic and non-academic staff and students) and external (funding organizations, industry representatives, prospective students and individuals interacting with HEIs). Examples of administrative services offered to students are career guidance services, counselling, participation in internship programs, accommodation in dormitories, and administration of the training conducted [5-8]. On the other hand, teachers provide academic services in a university environment that are directly related to the training provided in the academic disciplines [6]. Gupta and Kaushik [9] note that services have characteristics that distinguish them from products, and assessing their quality can be challenging.

According to Al-Ababneh and Alrhaimi [10], there is no single model of the education quality management system. Even though the effectiveness of higher education management depends on external factors arising in the educational system management, HEIs leadership responds to the educational process effectiveness and the quality of the services provided. It requires the implementation of innovative management methods based on modern information technologies.

The development of technologies in the period of globalization and the industrial revolution 4.0 has had a formidable impact on how organizations from various sectors, including HEIs, perform their daily work [11]. In the digital transformation process, HEIs should invest funds to develop their infrastructure to ensure prestige, meet minimum standards, and use technology to answer the students growing needs. When implementing new solutions, HEI management often must resolve conflicts with existing academic or administrative systems or procedures and staff antipathy to technological innovation. Managing and addressing all these challenges is critical to maintaining the quality of services offered and the effectiveness of HEIs [12]. For this reason, HEIs leadership should integrate all actions for quality

assurance into the management process in HEIs. Improving quality may require changes in various areas, such as human resource management, finance and budget, infrastructure, administrative services, etc. Therefore, to achieve the set goals, it is necessary to consider the assurance and evaluation of the quality of services as tools for the strategic development of HEIs [13]. During the transition from traditional to mixed learning, imposed by the Covid-19 pandemic, problems are emerging in terms of ensuring and maintaining the quality of education, including the compliance of educational programs with the requirements of the labour market, the expectations of students and their families, digital transformation of the educational process and economic stability of institutional networks [14–18].

All stakeholders (academic staff, administration, students, the general public, etc.) are concerned about assuring quality educational services. Quality management in higher education requires understanding the needs of all stakeholders [9], [19–21] and adopting and implementing strategic plans to enable higher education to reply to the needs of external (employers) and internal users (students and teachers) [22-23]. Kazeroony [24] believes many factors explain the need for restructuring strategies to deliver quality education, including the ever-changing characteristics of learners, technological advances and economic reasons. According to Bernhard, due to the demand for quality services, most academic institutions worldwide have undergone a significant transformation [25]. Kettunen believes that the only way to improve stakeholder confidence in the education system is by integrating a plan for quality education services into the overall institutional governance framework and implementing quality assurance systems [26-27].

The service quality in HEIs cannot be examined without considering the student as the primary user of the offered educational and administrative services. Student satisfaction significantly affects the sustainability and development of HEIs, and therefore HEIs leadership should focus on providing better service quality [28-29].

The process of providing quality services is focused on meeting student expectations, continuous improvement and sharing responsibilities [30]. This process ensures HEIs have done well and supported students throughout their training as much as possible. Arokiasamy and Abdullah underlined the need for HEIs to provide a well-rounded university experience due to the potential impact of student satisfaction on HEI competitiveness, student retention, and efforts to attract new students in a highly competitive higher education market [31]. HEI leadership should consider that prospective students gather information about the HEI by contacting current graduates and visiting the website and social media pages. The great satisfied students are more loyal to their HEI and spread positive comments and recommend the HEI to others [32]. Therefore, to ensure that an HEI has a competitive advantage over other HEIs, management should do activities to improve student feedback on the quality of administrative and educational services, seek ways to exceed student expectations and provide high-quality services [33–38]. Students' perspectives on the quality of educational services can be seen as a basis for adapting marketing efforts to answer student needs [6] and improve institutional performance [39].

According to many researchers, student satisfaction is an indicator of service quality in HEIs, and students' evaluation of the quality of educational services is an effective tool for improving the quality of HEIs [7], [31], [37], [40–52].

Based on a detailed analysis of developed questionnaires for evaluating the quality of services, this paper explores the possibilities of automation of the overall process for studying student satisfaction with the quality of services. Section II reviews different factors contributing to student satisfaction. Section III discusses various methods and tools used to measure student satisfaction. Section IV presents the developed prototype of a software tool for surveys conducted. Section V presents the results, which allows HEIs to make informed decisions to improve the quality of services and compare the results of their HEIs with those of competing universities. Section VI, conclusion, discusses the contributions, limitations of the study and plans for future research.

II. QUALITY OF SERVICES IN HEIs

Kara and DeShields [53] suggest HEIs recognizing the importance of student evaluation of quality services would, in most cases, meet the student's needs to a great extent. Several empirical studies have been conducted over the years on the factors contributing to student satisfaction. Douglas, Douglas and Barnes found [54] the quality of learning resources was not a determining factor. According to the results of other studies, the quality of resources is a vital component of the quality of educational services [55-56]. The quality of resources is a multidimensional construct evaluated by indicators for support teaching, learning and research activities in HEIs. Such indicators include lecture facilities, laboratory facilities, library services and access to information and communication technology (ICT) infrastructure and digital resources [57-58]. According to Arambewela and Hall, teaching style, innovative provision of knowledge, faculty support and feedback influence students' satisfaction [59]. Other researchers also point to innovative changes in curricula [60] and teaching methods [61] as determinants of student satisfaction. Muhsin, Nurkhin, Pramusinto, Afsari and Arham [62] also explored the relationship between university governance, teaching quality and student satisfaction and concluded that teaching quality, teaching facilities and good university governance have a positive and significant impact on student satisfaction. Tuan cites the services provided by the administrative staff, the know-how, skills and attitude of the academic and non-academic staff as leading factors in student satisfaction [63]. Similar are the main aspects influencing the quality of services in HEIs identified by Sultan and Wong [64] - academic environments, academic and non-academic staff. Another group of researchers identified technological, learning, executive and psychological environment as the main factors for student satisfaction [51], [65]. Kara, Tanui and Kalai identified learning facilities, availability of textbooks and library environment as determinants of student satisfaction [66]. Other researchers point to understanding and effective communication between students and staff within the education environment as a leading factor in determining service quality

and student satisfaction [2], [46]. According to Vinogradova, Kulyamina, Vasileva, Bronnikova and Vishnyakov, many factors can influence the formation of consumer expectations, such as the student's own needs, life experience, public opinion, the state of the educational organization, current information on the labour market [67]. According to Hoque, Akhter, Absar, Khandaker and Al-Mamun [29], among the main factors that influence student satisfaction are the comfortable of lecture halls, service timely provision, the capacity of non-academic staff to solve problems, experienced lecturers for teaching and research, and the focus of university management on students.

III. APPROACHES AND TOOLS FOR QUALITY ASSURANCE AND ASSESSMENT

The difficulties in identifying the quality dimensions make challenges in developing models and tools for evaluating the quality of services in higher education [13] and using industry models for service quality evaluation. Due to their limitations, imposed mainly by the centrality of student learning services, industry models can be used with partial success [19] and therefore have to be adapted to reflect the specifics of higher education.

Total quality management (TQM) is a widely used model for improving the performance of service providers and customer satisfaction. Companies that implement TQM [68] transform their organisational culture by engaging all their members to contribute to improving products, processes and services. Many HEIs implement TQM to respond to market pressures while producing high-quality results and striving for self-improvement due to their social contribution [69-70]. Some researchers are sceptical about its applicability in HIEs [71] before the identity and characteristics of education [72-74]. However, many scholars have found that TQM can address stakeholder expectations and challenges in HIEs [75].

The interest in developing models for assessing service quality began in the 1980s. In the beginning, research focused primarily on developing industrial models for evaluating customer satisfaction, such as the perception model customer-perceived service quality [76], SERVQUAL [77] and SERVPERF [78].

Marsh [79-80] proposed the SEEQ tool allowing students to assess the quality of teaching, content and learning in nine areas – Teaching/Course Value, Instructor Enthusiasm, Organization of Presentations and Materials, Group Interaction, Student-Teacher Interaction, Scope, Exams/Assessment, Tasks/Reading Materials, and Workload.

Parasuraman, Zeithaml and Berry [81] proposed a model for measuring service quality based on a multiple-item scale. SERVQUAL is based on the view that the evaluation of the service quality of customers is fundamental, and service quality is closing the gap between service expectations and perceptions. Researchers outline ten dimensions of service quality: Reliability, Responsiveness, Competence, Access, Courtesy, Communication, Trust, Security, Customer understanding and Tangibility. Dimensions in the model are defined as a measure of how well the level of service provided reply customer expectations. To overcome some difficulties in

evaluation, researchers proposed an updated version of the model in 1988. The updated version has five dimensions [77]: Tangible assets (physical facilities, equipment, staff, etc.), Reliability (the ability for reliable service provision), Responsiveness (willingness to serve and assist customers quickly), Security (employees' ability to inspire trust and confidence, politeness and awareness), Empathy (providing individual attention to customers). The evaluation is done through a questionnaire containing 22 questions to assess the five dimensions of the service, allowing for evaluating the customers' expectations and the service provider's performance. Due to its flexibility and ability to be adapted to sector-specific requirements, the proposed model is widely used to assess the quality of services in industries from various sectors, including retail, banking, healthcare and education [82–90]. According to several researchers, the SERVQUAL model is the most well-known and commonly used model for evaluating the quality of services in higher education, incl. from students [9], [39], [91–105].

Tan and Kek [91] used SERVQUAL to assess student satisfaction in Singapore and concluded that some cultural factors should be considered when developing the assessment questionnaires.

Dado, Taborecka-Petrovicova, Riznic and Rajic [92] used SERVQUAL to study the service quality in HEIs in Serbia. They conclude there is a significant gap between student expectations and perceptions. Legcevic, Mujic and Mikrut [94] also used SERVQUAL to identify the gap between students' expectations and perceptions of educational services in Croatia. The survey results show that the negative difference in service dimensions can be used as a guideline for planning and allocating resources to improve the quality of educational services. Over the years, researchers have developed several modified versions of the tool adapted for evaluating the quality of services in HEI.

Aghamolaei and Zare [106] proposed a modified version of the SERVQUAL instrument that allows the evaluation of the quality of educational services by students. The questionnaire measures perceptions and expectations of students from the service in five dimensions – Confidence, Responsiveness, Empathy, Reliability and Tangibility. Study results were analysed using SPSS13 software using descriptive statistics, paired t-test, Wilcoxon, Friedman and ANOVA. Using the proposed tool, 350 students evaluated the service quality.

Zafiropoulos and Vrana [107] developed a modified version of the model to assess the quality of services in HEIs in Greece from students and teachers. The evaluation study shows no significant differences in how students and academic staff perceive the quality of education.

The HEdQUAL tool (based on SERVQUAL) [108] allows students to evaluate the quality of services in HEIs. Students complete a questionnaire with 27 indicators divided into five groups: teaching and course content; administrative services; academic facilities; university infrastructure; support services. The creators underline the possibility of expanding the functionality of the service quality assessment tool by all stakeholders – academic staff, support and administrative staff.

Đonlagić and Fazlić [13] developed a service quality assessment tool based on SERVQUAL. The proposed questionnaire contains 25 questions for each scale: one to measure the expectations of students and one to measure their perception of the services provided. The questions cover all dimensions of the SERVQUAL model – tangible assets (four questions for equipment, infrastructure, interior, teaching materials, etc.), reliability (six questions for reliably providing the service, such as allowing student problems, claims and requests), responsiveness (three questions related to the provision of quick service to students), assurance (six questions to evaluate the knowledge and politeness of the academic and non-academic staff and their ability to express trust and confidence) and empathy (six questions for the individual attention given to students). Each question is rated on a 7-point Likert scale. HEIs leadership can use the results of the service quality evaluation as input for planning and strategy setting.

Hassan and Yusof proposed a modified version of SERVQUAL that allows the study of the difference between expectations and satisfaction of students with the quality of educational services [109]. The sub-dimensions of education service quality are Reliability, Assurance, Empathy, Responsiveness, Tangibles (program and service quality), Communication, Knowledge/Expertise, Systems/Secondary Services, Social Responsibility and Development. The authors used a questionnaire to collect the data and a t-test and discriminant technique for results analysis.

Guillén Perales [110] proposed an approach to assess the impact of the primary variable on service quality and determined its significance from students. The evaluation is in two stages. In the first stage, quality evaluation of the service is carried out based on the feedback collected from the students, using a modified version of the SERVQUAL model for this purpose. In the second stage, evaluators should compare the results obtained by students and academic staff. The proposed approach was tested for service quality evaluation by 580 students. The results reveal the most significant dimensions of service quality identified by students. The comparison of the results with those of the academic staff showed notable differences in quality evaluation.

Rizos, Sfakianaki and Kakouris [111] discussed the differences between students' perceptions and expectations of the quality of administrative services. They explored the quality of administrative services of an HEI by assessing student satisfaction in the TQM context. The developed questionnaire follows the SERVQUAL model. It contains 22 questions to research perceptions and expectations regarding the quality of administrative services adapted for the educational environment, divided into five dimensions: Tangibility, Reliability, Responsiveness, Assurance and Empathy. With the proposed tool, the quality evaluation of administrative services of 5 HEIs in Greece was carried out based on primary data from 104 students. The obtained results make it possible to formulate recommendations for importance and effectiveness.

Rozak et al. [18] proposed a model for evaluating the quality of educational services in HEIs based on the SERVQUAL model. Following the proposed model, the authors developed a questionnaire with 25 closed-ended questions on two scales: one to measure students' expectations regarding the quality of educational services and the other to measure student satisfaction. The collected data is analysed using numerical and statistical analysis techniques and tools such as SPSS. The validity and reliability of each of the items of the model dimensions are measured using the reliability test and the qualification of Cronbach's alpha scores. The collected data should be analysed using descriptive statistics. Using this tool, 236 students evaluated the service quality in Russia and Indonesia.

Hoque, Akhter, Absar, Khandaker, and Al-Mamun [29] developed an instrument to measure student satisfaction with service quality in private universities in Bangladesh based on the SERVQUAL model. The questionnaire developed to collect primary data contains 43 questions – 4 for demographic characteristics, 21 for quality of service, 10 for student satisfaction and 8 for student loyalty to the university. All these questions require a response on a 5-point Likert scale. During the pilot study, 229 students filled in the questionnaire. Primary data were analysed using AMOS 22 and structural equation modelling (SEM).

Ganbold, Park and Hong [112] proposed an approach for evaluating students' requirements regarding the quality of educational services in HEIs based on three models – SERVQUAL, KANO and TIMKO. The evaluation takes place in three phases. During Phase 1, using SERVQUAL, a measurement factor is determined to assess the quality of the educational service. The respondents' perceptions of service quality are classified using a two-dimensional quality classification scheme applying the KANO model. During the last phase, the degree of satisfaction and dissatisfaction of the students is calculated based on the TIMKO equation. This approach provides a satisfactory level of quality indicators to improve student satisfaction based on the PCSI index and ultimately allows HEIs leadership to develop a student satisfaction strategy. The tool was experimented with, to determine the degree of student satisfaction with higher education services in Mongolia and identify the quality characteristics that can improve student satisfaction based on the Potential Customer Satisfaction Improvement Index (PCSI).

The IPA importance-performance analysis is an exciting addition to the existing service quality measurement models [113-114]. According to this model, consumer satisfaction is a function of two components – the importance of the product to the customer and its performance by the service provider. IPA is a diagnostic tool that can identify attribute importance and a product or service benefits to satisfy customer needs [114, 115]. As it diagnoses the main disadvantages and sets the priorities using this tool, companies can overcome the shortcomings of SERVQUAL and discover their strengths and weaknesses. IPA uses a matrix in which one axis measures supplier performance, and the second axis measures customer importance [116]. Due to its simplicity and usefulness in making significant management decisions, IPA is used to evaluate service quality in various fields [117], including higher education [118]. Some researchers fault the model before the applied methods of dividing the quadrants and

evaluating the results. As a result, some modifications have been proposed [113], [119–121].

Researchers doubt the SERVQUAl model because perceptions and expectations are measured together after consumers use the service. On the one hand, this may subconsciously change expectations, and on the other hand, evaluating the service before submitting give often a different result [122-123].

According to Cronin and Taylor, the relationship between expected and received quality is not an appropriate approach for evaluating service quality, and they suggest considering it as a predictor of the service quality only perceptions [78]. The developed SERVPERF model includes 22 items to measure customer satisfaction with service. According to researchers [83], [124] SERVPERF outperforms SERVQUAL in selecting the most effective service quality model in developing countries.

As a result of research, Abdullah [125] researched the general applicability of the SERVPERF model in HEIs. He proposes a modified version for assessing student satisfaction with the services offered. HedPERF includes 49 quality indicators specific to higher education (13 from the SERVPERF model), divided into six dimensions – Non-academic aspects, Access, Academic aspects, Clarity, Reputation and Programmatic issues. Since it is based on SERVPERF, it also assesses service quality as a performance function. The tool was tested for validity and reliability by conducting an empirical study. As disadvantages of the model, researchers point to the overlapping of questions, the emphasis on administrative aspects, its limitations for evaluating other services, and the small number of HEIs in which HedPERF has been tested [88], [126].

Shaik, Lowe and Pinegar [127] proposed a tool to measure the quality of distance learning from students. The developed DL-sQUAL tool allows assessment of the quality of 23 services, divided into three areas – Quality of training services, Management and administrative services and Communication. Based on the evaluation results, administrators can identify services that need to be improved and opportunities for staff training. According to its creators, only administrators of distance learning can use the DL-sQUAL to assess the strengths and weaknesses of the services offered.

Hussain and Birol [6] developed a tool to evaluate student satisfaction with service quality based on SERVQUAL and SEEQ. They suggest three dimensions for quality evaluation: service quality (non-academic services), learning quality (academic services) and student satisfaction. The first two dimensions (non-academic and academic services) are considered multidimensional constructs and independent learning variables, and satisfaction is the dependent learning variable. Service quality is assessed in five areas (tangibility, reliability, responsiveness, confidence and empathy) and learning quality in nine areas (Learning values, Instructor enthusiasm, Course organization, Breadth of coverage, Group interaction, Individual understanding, Examination/assessment rules, Tasks and Workload). The proposed questionnaire contains 59 questions – 22 for service quality (based on SERVQUAL), 33 for learning quality (based on SEEQ), and 4

for student satisfaction. All these questions require a response on a 5-point Likert scale. A pilot study of the tool was conducted in Cyprus involving 330 students. The authors use means, standard deviation and frequencies, reliability analysis, exploratory factor analysis and regression analysis for results analysis.

Adapting the so-called "360-degree feedback" for evaluating the human resources management of a given company has been created as a tool for quality evaluation of management activities in HEIs [128, 129]. The teachers, students and graduates give feedback based on criteria defined according to the evaluated object (curriculum, processes, disciplines, etc.). Each stakeholder evaluates only these criteria for which (s)he has the necessary knowledge or experience.

Kara, Tanui and Kalai [66] explored the relationship between educational quality service and student satisfaction and developed an instrument to evaluate educational quality service and student satisfaction. The questionnaire contains 64 questions – 26 for academic resources, eight for administrative services, 22 for teaching and eight for social services offered. All these questions require a response on a five-point Likert scale. Using the questionnaire, the authors evaluate the quality of services in eight universities in Kenya by collecting primary data from 1062 students. They used factor analysis, descriptive statistics and regression analysis for data analysis.

Based on Harvey and Green's [130] quality framework, Kivistö and Pekkola [4] underlined a possible understanding of the dimensions of quality in HE administration – quality as exclusivity/excellence, quality as perfection/consistency, quality as fitness for purpose, quality as value for money, quality as transformation. According to them, the main tools for ensuring the quality of administrative services are regulations and action plans, administration audits, conducting periodic surveys among the users of administrative services (academic staff, non-academic staff, students, external stakeholders), analysis of quantitative data for financial and human resources and cost measurement, performing benchmarking and conducting internal forums for open dialogue and sharing of experience on the use of administrative services.

Vnoučková, Urbancová and Smolová [131] evaluated key internal quality management processes from students and identified factors for effective internal quality process management. They offered a tool for the quality of the management process evaluation in five key areas – leadership and strategic planning, focus on students and stakeholders, measurement of student learning outcomes, human resources planning and education process management. The authors used a quantitative study (filling in questionnaires) and a qualitative study within the target groups to collect data for evaluation. Students rated all indicators in the questionnaire on a five-point Likert scale. Primary data from the questionnaires are analysed using descriptive statistics and bivariate statistical methods.

According to Lestari and Khusaini [46], analytical tools can support HEIs in fulfilling their vision and mission. They are suitable for measuring student satisfaction and can be used to evaluate the quality of educational services. They offer a tool for assessing student satisfaction with the quality of academic

and non-academic administrative services and the availability of educational facilities. The evaluation is going on a proposed model with indicators in 5 areas – Reliability, Responsiveness, Confidence, Empathy and Physical evidence. The primary data for conducting the study were collected by filling in questionnaires from 184 students who evaluated the indicators using a five-point Likert scale. The survey results are analysed by comparing the differences in expectations and satisfaction in using the service, conducting a matched pairs test using SPSS and showing in a Cartesian diagram.

Prima and Saputra [132] considered the level of satisfaction of customers as a measure of the quality of services in HEIs. They propose a service quality assessment model based on previous research in the field [133] with ten dimensions (reality, responsiveness, competence, access, courtesy, communication, reliability, security, customer understanding/knowledge and tangibility) divided into five main areas – Reliability, Responsiveness, Assurance (competence, courtesy, security), Empathy (access, communication and understanding of the customer) and Tangibility.

Mastoi, Xin Hai and Saengkrod [3] explored the level of student satisfaction with the quality of administrative services, educational services, support facilities and physical environment. Based on an extensive literature review and qualitative data collection from interviews conducted with students and faculty, they identified five main dimensions of HESQUAL that were considered independent determinants for evaluating a dependent variable for overall student satisfaction – administrative quality, physical environment quality, the primary educational quality, the quality of the support facilities and the transformative quality. They collected the data for conducting the study from 500 questionnaires, did results analyses in SPSS and used multiple linear regression analysis to evaluate the role played by each factor in predicting student satisfaction.

Amoako and Asamoah-Gyimah [51] explored the factors contributing to student satisfaction with educational services and the quality assurance of services offered by HEIs. They offered two instruments – to evaluate the overall satisfaction of teachers and students from the quality of services. The questionnaire for students was developed based on previous research by Stukalina [65] and contains 19 questions divided into three dimensions - Technological environment (assesses the availability, adequacy and access to modern technologies in the context of their studies), Learning Environment (assesses the situation in the classroom and the teaching approach), The psychological environment (evaluates belonging to the academic family). The developed instrument assessed the satisfaction with educational services of 1500 students in Ghana. Researchers used Analysis of Moment Structures (AMOS) to validate the tool and test the hypotheses.

Montemayor [134] studied the ongoing procedures, prevailing practices and beliefs, conditions for existing relationships, perceived effects, and developmental trends. This process goes beyond simple data collection and tabulation. Primary data for the study were collected using a questionnaire and survey results were processed with SPSS v. 23.

Lian and Putra [11] proposed a methodology for evaluating the effectiveness and role of educational administration in HEIs in the digital era. They suggested a quantitative approach to measure data for efficacy and a qualitative approach to analyse the data according to the role. For the quantitative analysis, a questionnaire was developed to evaluate the administration with questions in four areas – goal achievement (effectiveness of the set goals), system (availability of resources and the connection with the external environment), strategic groups (level of satisfaction) and competitive values (criteria for success with educational administrative factors such as educational facilities, infrastructure, finance and environment). Each question requires a response on a five-point Likert scale. Qualitative research is conducted through observations, literature studies and interviews. The proposed approach has been used to evaluate the effectiveness of educational administration at PGRI Palembang University, Indonesia.

Vinogradova, Kulyamina, Vasileva, Bronnikova and Vishnyakov [67] identified criteria and indicators for evaluating educational services and developed a methodology for measuring the quality of educational services in HEIs. They proposed 33 quantitative indicators for quality evaluation, divided into five areas – Educational programs (10), Teaching staff (6), Educational technologies (6), Material and technical provision of the educational process (5), and Management of education processes (6). They define weights and formulas for calculating the score for each area and indicator. Based on the indicators' scores, they calculate a composite factor of the quality of educational services as considered the area weight in the calculation formula). In this way, the composite coefficient makes it possible to evaluate the quality of educational services in quantitative terms, the maximum value of which is 1. The proposed methodology allows objective evaluation and helps the HEIs leadership to take measures to improve the quality of educational services.

Krymets, Saienko, Bilyakovska, Zakharov, and Ivanova [23] proposed an approach to determining the requirements for the quality of education from the perspective of administrative staff, students and employers, developed based on stakeholder theory and TQM. The approach involves a survey with sets of questions for different stakeholder groups – Administrative/support staff (14 items), Teaching staff (19 items), Students (26 items), and Industry (15 items). They developed four frameworks with requirements to meet the needs of all users of educational services and to ensure the evaluation of the overall quality of higher education. Each question requires a response on a five-point Likert scale. For each statement, employer respondents rated both the expectations of graduates and the actual student performance in the workplace. The survey results were processed with Statistica 22.0 using basic analysis methods – Cronbach's α to check the reliability of the constructed sets of questions and Pearson's correlation to assess the reliability of perception and stakeholder requirements analysis.

Tran [135] offered a tool to assess students' perception of the quality of educational services with 22 questions divided into five areas – Educational services (four for admission services, transfer, fees, etc.), Facilities and equipment (four for classrooms, equipment, teaching aids, level of safety and

hygiene), Educational environment (five for attitude, enthusiasm and correctness of teachers during educational activities), Educational activities (four for training activities), Development and progress of students (five for evaluating learning results). All questions require a response on a five-point Likert scale. During the pilot evaluation, the authors used SPPS software for results analysis.

Hai [136] investigated the factors influencing student satisfaction with service quality in HEIs. To conduct the study, Hai collected data from 396 students. During structured discussions, participants are presented with a list of factors and asked to give their opinion on the listed factors and add some missing factors. Hai used SPSS 20, Cronbach's Alpha reliability coefficient, EFA, CFA and SEM for results analysis.

The results show that six factors influence student satisfaction with the quality of services – teaching staff, facilities, serviceability, educational activities, student support activities and educational programs.

Assiri [137] explored the most significant technical, human, economic, social and administrative obstacles and requirements to make suggestions for using e-government to improve the quality of education services in Saudi Arabia. He developed a tool to identify difficulties in implementing e-administration in HEIs from the perspective of employees and teachers.

Table I summarizes the criteria and the evaluation target (Expectation/Satisfaction) of the studied models for quality evaluation. The comparison proves that many factors affect the quality of the services offered in the education system.

TABLE I. COMPARISON OF STUDIED MODELS

Approach Authors	Criteria	Expectations/ Satisfaction
Students Evaluations of Educational Quality (SEEQ) Marsh 1982, 1987	Training/Course Value Enthusiasm of Instructors Organization of Presentations and Materials Group Interaction Student-Teacher Relationship; Exams/Assessments, Assignments/Reading Materials, Workload.	Satisfaction
SERVQUAL Parasuraman, Zeithaml и Berry 1985, 1988	Reliability, Responsiveness, Competence, Access, Courtesy, Communication, Trust, Security, Customer Understanding and Tangibility.	Expectations and satisfaction
Modified SERVQUAL models - Tan, Kek 2004; Dado et al., 2011; Legcevic et al., 2012; Aghamolaei, Zare,2008; Zafiropoulos & Vrana, 2008	Confidence, Responsiveness, Empathy, Reliability and Tangibility.	Expectations and satisfaction
HEdQUAL Icli & Anil, 2014	Teaching and Course content; Administrative services; Academic facilities; University infrastructure and support services.	Expectations and satisfaction
Đonlagić & Fazlić, 2015	Tangible assets (equipment, infrastructure, interior, teaching materials, etc.) reliability (reliable service delivery, resolution of student problems, claims and requests), responsiveness (quick service), confidence (knowledge and courtesy of academic and non-academic staff, expression of trust and confidence) and empathy (given individual attention).	Expectations and satisfaction
Hassan & Yusof 2015	Reliability, confidence, empathy, responsiveness, tangibles (program and service quality), communication, knowledge (expertise), systems (secondary services), social responsibility and development.	Expectations and satisfaction
Rizos et al., 2022	Tangibility, reliability, responsiveness, confidence and empathy.	Expectations and satisfaction
Rozak et al., 2022	Confidence, Responsiveness, Empathy, Reliability and Tangibility	Expectations and satisfaction
Hoque et al., 2023	Demographic characteristics, Quality of service, Student satisfaction and Student loyalty to the university.	Satisfaction
Importance performance analysis IPA Abalo 2007; Sever 2015	Importance of an item to the customer, Benefits of a product or service to meet customer needs, and Performance by the service provider.	Satisfaction
SERVPERF Cronin & Taylor, 1992	22 items to measure customer satisfaction.	Satisfaction
HedPERF Abdullah, 2006	Non-academic aspects, access, academic aspects, clear understanding, reputation and programmatic issues.	Satisfaction
DL-sQUAL Shaik et al., 2006	Quality of training services, Management and administrative services and Communication.	Expectations and satisfaction
Hussain & Birol, 2011	Quality of services (non-academic), Quality of teaching (academic), Student satisfaction.	Satisfaction
Kara, Tanui & Kalai 2016	Quality of academic resources, Quality of administrative services, Teaching and of the social services offered.	Satisfaction
Vnoučková et al., 2018	Leadership and strategic planning, Student and stakeholder focus, Measurement of student learning outcomes, Human resource planning and management of the educational process.	Satisfaction
Lestari & Khusaini, 2018	Reliability, responsiveness, confidence, empathy and physical (material) evidence.	Expectations and satisfaction
Prima & Saputra, 2019	Reliability, Responsiveness, Assurance (competence, courtesy, reliability and security), empathy (access, communication and understanding of the customer) and Tangibility.	Satisfaction
HESQUAL Mastoi et al., 2019	Administrative quality, Physical environment quality, Basic educational quality, Facilities quality, Transformative quality.	Satisfaction
Amoako et al., 2020	Technological Environment, Learning Environment, Psychological Environment	Satisfaction
Vinogradova et al., 2021	Educational programs (10 indicators), Teaching staff (6 indicators), Educational technologies (6 indicators), Material and technical provision of the educational process (5 indicators), and Management of educational processes (6 indicators).	Satisfaction

Krymets et al., 2021	Administrative (support) staff (14 items grouped into 4 factors), teaching staff (19 items into 5 factors), Students (26 items into 5 factors), and Industry (15 items into 4 factors).	Expectations and satisfaction
Tran et al., 2022	Educational services (4 indicators), Facilities and equipment (4 indicators), Educational environment (5 indicators), Educational activities (4 indicators), and Development and progress of students (5 indicators).	Satisfaction
Hai, 2022	Faculty, Facilities, Service capacity, Educational activities, Student support, and Educational programs.	Satisfaction
Assiri, 2023	Technical, Human, Economic, Social and administrative obstacles and requirements for using e-government.	Satisfaction

Several test evaluations of the quality of services in specific HEIs have been carried out using the developed tools. Part of these surveys was organized using software solutions for surveys, such as Google Forms. The conduction of similar surveys with such tools has some disadvantages – the possibility of providing access to the survey questionnaire to external persons, manual data processing when detailed analysis of results is necessary, difficulties in tracking trends in assessments, etc.

Few studies have addressed the issue of monitoring the results of conducted studies [138-139]. None of the considered tools automates the overall process of evaluating student satisfaction, comparing results of individual HEIs and generating recommendations that can support HEIs leadership in decision-making. To ensure the high quality of the services, it is vital HEIs leadership not only to conduct periodic surveys, the results of which should be made public, but also to implement tools that analyse results and present them in a summarized form and allow them to make informed decisions to improve the quality of the services offered. Based on the results, HEIs leaders can identify weaknesses and take measures to improve problem areas to answer the needs of students and ensure student satisfaction with the quality of service provided by the institution's employees.

Despite the various factors, all models have a two-level hierarchical structure and require evaluation on a defined scale (in most cases five- or seven-point Likert scale). This fact enables HEIs leadership to search for solutions to automate the whole process of evaluating the quality of services in HEIs, from conducting surveys, and survey results analysis to the generation of evaluation reports.

IV. SOFTWARE TOOL PROTOTYPE

Automating the overall process for evaluating the quality of educational services from students requires the design, development and implementation of a software tool that allows:

- modelling of a questionnaire for evaluating the quality of educational services, including assigning weights to evaluated indicators;

- provide an opportunity for students to fill in questionnaires;

- generation of reports with the survey results for a specific HEI;

- generation of recommendations for improving the quality of educational services offered in HEIs;

- generation of reports for comparing the results of different HEIs.

The project for a software tool for evaluating student satisfaction with the quality of services offered includes the following six subsystems:

- Subsystem 1: Conceptual modelling of questionnaires (areas, indicators, weights) for quality evaluation;

- Subsystem 2: Modelling and managing quality evaluation procedures in specific HEIs;

- Subsystem 3: Evaluation of the quality of services by students according to the modelled questionnaire;

- Subsystem 4: Modelling of report templates for summarizing the evaluation results;

- Subsystem 5: Generation of reports (for individual HEIs and summary reports) for evaluating the quality of services in HEIs;

- Subsystem 6: Generating recommendations for improving the quality of services.

The developed software prototype UQCS is an online tool for evaluating the quality of educational services in HEIs by students. The tool generates recommendations and reports with evaluation results, allowing HEIs leadership to make informed decisions for improving the quality of services.
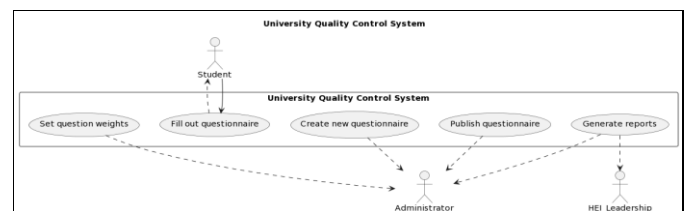

Fig. 1. The UML diagram of the university quality control system (UQCS).

The UML diagram shows (see Fig. 1) the main actors in the system (Student, Administrator and HEIs leadership) and the use cases they can perform. The use cases are:

- UC1: Create new questionnaire;

- UC2: Set question weights;

- UC3: Publish questionnaire;

- UC4: Fill out questionnaire;

- UC5: Generate reports.

Administrators can create a new questionnaire (UC1) by specifying the questions that will be included in the questionnaire and setting the weights for all questions (UC2) that determine how much each question contributes to the overall score of the questionnaire. Once the Administrators create the questionnaire and set the weights of the questions, they can publish the questionnaire so that students can start

filling it out (UC3). The Student can complete the questionnaire by answering questions and submitting their answers (UC4). Administrators and HEIs leadership can generate reports summarizing the evaluation results and recommendations (UC5). They can use these reports to track the quality of education at the university and identify areas where HEIs leadership can make improvements. The management of HEIs can review the evaluation results and the generated recommendations and compare the achievements of the HEI they manage with those of other universities. The arrows between the actors and use cases show the relationships between them. For example, the arrow from Student to UC4 shows that the Student can perform the Fill out questionnaire use case.

Subsystem 1 allows the administrator to create questionnaires that evaluate the quality of services provided in HEIs and assign weights to each question to reflect its importance. Using this subsystem, the administrator can model all the questionnaires considered in Section III. These are just a few of the screens that users see in Subsystem 1.

- *Questionnaire preview screen*: Users see this screen to preview a questionnaire before it is published. They can see how the questionnaire will look and how the questions will be presented;

- *Questionnaire publishing screen*: Users see this screen to publish a questionnaire. Once a questionnaire is published, it will be available for students to fill in.

Insert University

Name:

Location:

Country:

Website:

Phone:

Submit

Fig. 2.   Insert form for university data.

Subsystem 2 allows administrators to create and manage quality assessment procedures for specific HEIs. The performed procedures can include different stages, such as distributing questionnaires, collecting responses, processing responses, and generating reports. The subsystem is sending emails to HEIs leadership about the organized survey. Users see the *Questionnaire creation screen* when they want to create a new questionnaire. They can enter the title of the questionnaire, add questions, and preview the questionnaire before publishing it. Fig. 2 shows the screen for insert of data for a new University in the Database.

Subsystem 3 allows students to fill in questionnaires to assess the quality of services provided in the HEI. The questionnaires are distributed within the quality assessment procedures created in Subsystem 2. After completing the questionnaire, the student's answers are recorded in the system database. Each student can fill in the questionnaire only once.

The database UCQS contains the following tables:

- *Questionnaire Table* – stores information about the questionnaires created by the administrators;

- *Question Table* – stores the questions associated with each questionnaire;

- *Student Response Table* – stores the responses of students to each question;

- *University Table* – stores information about different HEIs.

Fig. 3 the most significant part of the Python code using Flask that provides an HTTP API for the main functions of the "University Quality Control" system. This API allows users to create questionnaires, submit student responses, and retrieve results and recommendations.

```python
from flask import Flask, request, jsonify
app = Flask(__name__)
# Sample data storage (you should use a database in a real application)
questionnaires = []
responses = []
# Endpoint to create a new questionnaire
@app.route('/api/questionnaires', methods=['POST'])
def create_questionnaire():
    data = request.get_json()
    title = data.get('title')
    description = data.get('description')
    questions = data.get('questions')
    if not title or not description or not questions:
        return jsonify({'message': 'Incomplete data. Title, description, and
questions are required.'}), 400
    questionnaire = {
        'title': title,
        'description': description,
        'questions': questions
    }
    questionnaires.append(questionnaire)
    return jsonify({'message': 'Questionnaire created successfully.'}), 201
# Endpoint to submit student responses
@app.route('/api/responses', methods=['POST'])
def submit_response():
    data = request.get_json()
    questionnaire_id = data.get('questionnaire_id')
    student_id = data.get('student_id')
    responses = data.get('responses')
    if not questionnaire_id or not student_id or not responses:
        return jsonify({'message': 'Incomplete data. Questionnaire ID, student ID,
and responses are required.'}), 400
    response = {
        'questionnaire_id': questionnaire_id,
        'student_id': student_id,
        'responses': responses
    }
    responses.append(response)
    return jsonify({'message': 'Student response submitted successfully.'}), 201
# Endpoint to retrieve questionnaire results
@app.route('/api/questionnaires/<int:questionnaire_id>/results',
methods=['GET'])
def get_questionnaire_results(questionnaire_id):
    questionnaire = next((q for q in questionnaires if q['questionnaire_id'] ==
questionnaire_id), None)
    if not questionnaire:
        return jsonify({'message': 'Questionnaire not found.'}), 404
    # Calculate results based on responses (you'll need to implement this logic)
    results = calculate_questionnaire_results(questionnaire_id)
    return jsonify(results), 200
# Endpoint to generate recommendations
```

```
@app.route('/api/questionnaires/<int:questionnaire_id>/recommendations',
methods=['GET'])
def get_recommendations(questionnaire_id):
  questionnaire = next((q for q in questionnaires if q['questionnaire_id'] ==
questionnaire_id), None)
   if not questionnaire:
     return jsonify({'message': 'Questionnaire not found.'}), 404
   # Generate recommendations based on results (you'll need to implement
this logic)
   recommendations = generate_recommendations(questionnaire_id)
   return jsonify(recommendations), 200
def calculate_questionnaire_results(questionnaire_id):
   return {'questionnaire_id': questionnaire_id, 'results': {'question1': 4,
'question2': 3}}
def generate_recommendations(questionnaire_id):
     return {'questionnaire_id': questionnaire_id, 'recommendations':
['Improve teaching methods', 'Enhance student support']}
if __name__ == '__main__':
   app.run(debug=True)
```

Fig. 3. Part of software code.

In the beginning, the necessary modules are imported, including Flask, and an instance of the Flask application is created. Lists in memory (questionnaires and answers) are used for temporary data storage. In a real-world application, you need to use a database to store the data. Here we define four API endpoints using the @app.route() decorator: /api/questionnaires: POST endpoint to create a new questionnaire; /api/responses: POST endpoint to submit student responses; /api/questionnaires/ <questionnaire_id>/results: GET endpoint to retrieve questionnaire results;/api/questionnaires/<questionnaire_id>/recommendatio ns: GET endpoint to generate recommendations. The create_questionnaire() endpoint allows the administrator to create a new questionnaire by providing a title, description, and a list of questions. The submit_response() endpoint allows students to submit their responses to a specific questionnaire by providing the questionnaire ID, student ID, and responses. The get_questionnaire_results() endpoint retrieves the results for a specific questionnaire, calculated based on the submitted responses. The get_recommendations() endpoint generates recommendations for improving the quality of services based on the results of a specific questionnaire. The calculate_questionnaire_results() and generate_recommenda-tions() are sample functions representing the logic for calculating questionnaire results and generating recommendations. You should replace them with the actual implementation based on your requirements. The if __name__ == '__main__': block runs the Flask application in debug mode.

Fig. 4 is a part of the Python Flask code that verifies the student user using a simple username and password combination. In a real-world application, one would typically use a more secure authentication mechanism such as JWT (JSON Web Tokens) or OAuth2. We import the necessary modules, including Flask, and create an instance of the Flask app. We use an in-memory dictionary (student_ credentials) to store the student usernames and passwords. In a real-world application, you should use a database and securely hash the passwords. We define a route /login using the @app.route() decorator. This route expects a POST request with a JSON payload containing the username and password. The login() function handles the login request. It checks if the provided username and password match the credentials stored in

student_credentials. If the login is successful, the function returns a JSON response with a success message and an authentication token. In this example, we are using a simple string as the token, but in a real application, you should use JWT or a similar authentication token mechanism. If the login fails (incorrect username or password), the function returns a JSON response with an error message.

```
from flask import Flask, request, jsonify
app = Flask(__name__)
# Sample student credentials (replace with actual credentials or use a
database)
student_credentials = {
   #...
}
# Sample authentication token (replace with JWT or OAuth2 token in a real
application)
def generate_token(username):
   return f'TOKEN_{username}'
# Route to handle student login
@app.route('/login', methods=['POST'])
def login():
   data = request.get_json()
   username = data.get('username')
   password = data.get('password')
   if not username or not password:
   return jsonify({'message': 'Username and password are required.'}), 400
   # Check if the provided username and password match the stored credentials
  if username in student_credentials and student_credentials[username] ==
password:
     token = generate_token(username)
     return jsonify({'message': 'Login successful.', 'token': token}), 200
   else:
     return jsonify({'message': 'Invalid username or password.'}), 401
```

Fig. 4. Part of software code for verification.

Subsystem 4 allows users to create report templates that summarize the results of evaluating the quality of services. We used Jasper Reports Server as a reporting tool to implement Subsystem 4, which involves modelling report templates with evaluation results. Using JasperSoft Studio, we designed four report templates and defined their corresponding parameters (see Table II).

TABLE II. A LIST OF DEVELOPED TEMPLATES OF REPORTS

Template	Parameter	Visualized data
Detail results of HEI	Survey ID HEI ID Survey period	Average scores by evaluated indicators (questions)
Summarized results of HEI	Survey ID HEI ID	Average scores by evaluated areas
HEIs ranking	Survey ID Survey period	Calculated average grades of HEIs
Detail HEIs ranking	Survey ID Survey period	Calculated average grades of HEIs for each evaluated area

During this stage, we designed SQL queries and data adapters to retrieve evaluation results from the UQCS database and populate the elements of report templates. After the user input parameter values, JasperSoft Studio fills in all data storage elements of templates with data retrieved from the UQCS database stored from Subsystem 3. The calculation of average scores is embedded in the developed document templates. The formula used considers both the grades given by the students on each indicator (question) and the assigned weights.

Subsystem 5 allows users to generate reports to assess the quality of services provided in HEIs. They can generate reports for an individual HEI or a group of HEIs. Subsystem 5 can run all developed templates (developed within Subsystem 4) stored in the Jasper Report Server. For this to be possible, a connection is required between Subsystem 3 (that store the evaluation results) and the Jasper Report Server. Based on this integration, the subsystem passes data to Jasper Reports Server for report generation. To enable report generation from the UQCS, a mechanism to trigger the report generation based on user requests has been implemented in Subsystem 5. Before report generation, the user must select the name of the report template and submit parameter values. The value of the HEI ID parameter is passed by the UQCS tool to eliminate the possibility of generating a report with the results of another HEI. The user must input values for other parameters (Survey ID and Survey period) as select sequentially values from drop-down lists. After receiving parameter values, JasperReport Server retrieves data from the UQCS database, calculates the results and fills in the report template with data. Then, JasperReport Server returns a completed report to the UQCS tool. The UQCS display reports on the screen and allows users to download them in the desired format (e.g., HTML, DOCX, XLSX, PDF, CSV) and share it with different stakeholders. Fig. 5 presents a part of the Python Flask client code that interacts with the Jasper Reports Server to generate and download a report.

```
import requests
app = Flask(__name__)
# Function to generate and download a report from Jasper Reports Server
def generate_report(report_template, parameters):
    jasper_server_url = 'http://jasper_reports_server_url'
    username = 'your_jasper_username'
    password = 'your_jasper_password'
    # Authenticate with Jasper Reports Server
    auth_url = f'{jasper_server_url}/jasperserver/rest_v2/login'
    auth_data = {'j_username': username, 'j_password': password}
    auth_response = requests.post(auth_url, data=auth_data)
    if auth_response.status_code != 200:
        return 'Authentication Failed.', 401
# Generate the report
    report_url =
f'{jasper_server_url}/jasperserver/rest_v2/reports/{report_template}'
    headers = { 'Authorization': f'Basic {auth_response.text}',
        'Content-Type': 'application/json'}
    report_response = requests.post(report_url, headers=headers,
json=parameters)
     if report_response.status_code != 200:
        return 'Report Generation Failed.', 500
    # Download the report
    download_url = report_response.json()['outputResource']['uri']
    download_response = requests.get(download_url, headers=headers)
    if download_response.status_code == 200:
        # Save the report to a local file
        with open('generated_report.pdf', 'wb') as file:
            file.write(download_response.content)
        return 'Report Generated Successfully.', 200
    else:
        return 'Report Download Failed.', 500
# ….. Some code omitted
```

Fig. 5.   Part of software code for interaction with Jasper Reports Server.

The Flask client code provides an endpoint /generate_report that triggers the generation and download of a report from the Jasper Reports Server. The generate_report() function handles the interaction with Jasper Reports Server. It performs authentication using the provided username and password and generates the report using the specified report template and parameters. The trigger_report_generation() route demonstrates how to trigger the report generation. Replace your_report_template_name with the actual name of the report template on Jasper Reports Server, and value1 and value2 with the required parameters. The generated report is saved locally as generated_report.pdf.

Subsystem 6 allows HEIs leadership and the administrator to generate recommendations for improving the quality of services provided. The recommendations are based on the results of the quality assessment. The Subsystem selects all evaluated areas with a result score of less than four and generates a recommendation for it. The recommendation is generated using Google Bard Artificial Language Model and the Python bardapi Library (see Fig. 6). This subsystem makes use of the following screens:

- *Questionnaire results screen:* Users see this screen to view the results of a questionnaire. They can see how students responded to the questions and the overall score of the questionnaire.

- *Recommendations screen:* Users see this screen to view recommendations for improving the quality of services based on the results of a questionnaire.

```
import bardapi
def generate_recommendations(areas, scores):
  """
  Generates recommendations for improving the quality of services in a
university based on the evaluated areas and scores.
  Args:
    areas: A list of areas.
    scores: A list of scores for each area.
  Returns:
    A list of recommendations.
  """
  recommendations = []
  for i in range(len(areas)):
    if scores[i] < 4:
      recommendation = "Improve " + areas[i]
      explanation = bardapi.generate_explanation(areas[i])
      recommendations.append((recommendation, explanation))
  return recommendations
```

Fig. 6.   Some of the code of the recommendations generator.

This would return the following example list of recommendations (see Fig. 7):

```
[("Improve instructional quality", "The instructional quality can be improved
by hiring more qualified professors, providing more resources for students, and
creating a more supportive learning environment."), ("Improve student-faculty
interaction", "The student-faculty interaction can be improved by creating more
opportunities for students to interact with professors, providing more support
for student-led initiatives, and creating a more welcoming and inclusive
environment."), ("Improve curriculum", "The curriculum can be improved by
making sure that the courses are relevant to the needs of students, providing
more opportunities for hands-on learning, and ensuring that the curriculum is
aligned with the university's mission.")]
```

Fig. 7.   Example list of recommendations for instructional quality improved.

V. RESULTS

The software tool UQCS was tested to assess the quality of services in three universities. After completing questionnaires created using Subsystem 1, users generated some reports with the evaluation results.

Here are some screenshots of reports generated by a user with the role "HEIs leadership" during the pilot testing of the tool. Data for experimenting were collected from completed questionnaires for evaluating the quality of services in nine areas (Instructional Quality, Student-faculty Interaction, Curriculum, Support Services, Campus Environment, Value for money, Quality of life, Student diversity, Career opportunities) by students from three universities. The Likert scale values for each question are on a scale of 1 to 5, with 1 being strongly disagree and 5 being strongly agree. The total score for each university is calculated by adding up the Likert scale values for all 10 evaluated areas.

Fig. 8 presents the generated report with summary results of one HEI who participated in the experiment. It shows the calculated average marks for each evaluated area and the overall student satisfaction mark. Based on the results, the HEI leadership can gain insights into which areas the university shows poor results and make informed decisions for improving the quality of services in these areas.

Report: Summarized results of HEI

HEI:

Survey: *Students' Satisfaction with Services*

Period: *2022-2023 academic year*

Criteria	Average satisfaction mark
Instructional Quality	4.00
Student-faculty Interaction	4.50
Curriculum	4.00
Support Services	4.50
Campus Environment	4.00
Value for money	4.00
Quality of life	4.50
Student diversity	4.00
Career opportunities	4.50
Overall Satisfaction Mark	**4.22**

Fig. 8. Summarized results of HEI.

Fig. 9 shows a generated report with calculated overall satisfaction marks of all HEIs who participated in the experiment. The calculated scores allow the results of HEIs to be compared and their leaders to make informed decisions to improve the quality of services, which will lead to a rise in the ranking and an increase in the prestige of the HEI.

Report: HEIs ranking

Survey: *Students' Satisfaction with Services*

Period: *2022-2023 academic year*

University	Overall satisfaction mark
	4.53
	4.22
	3.80

Fig. 9. HEIs ranking.

Fig. 10 shows a generated report with recommendations for improving the quality of services in one of the evaluated universities.

Recommendations for Improving Educational Service Quality

University:

Evaluation Period: Spring Semester 2023

Improve Student-faculty Interaction	Strengthen Curriculum
The student-faculty interaction can be improved by creating more opportunities for students to interact with professors, providing more support for student-led initiatives, and creating a more welcoming and inclusive environment.	The curriculum can be strengthened by ensuring that courses are relevant to students' needs, providing more hands-on learning opportunities, and aligning the curriculum with the university's mission.
Enhance Support Services	**Foster Campus Environment**
Support services can be enhanced by extending library operating hours during critical periods and establishing a dedicated student support helpline for academic and administrative queries.	Foster a positive campus environment by investing in green spaces, creating communal areas for students to interact, and promoting a sense of belonging through diverse events and activities.

Fig. 10. Generated recommendations.

VI. CONCLUSION

The proposed approach automates the overall process for measuring student satisfaction with the quality of educational and administrative services in HEIs. The developed tool automatically analyzes the collected data. HEIs leadership can use it to generate summary reports with survey results allowing them to track the satisfaction of their students and compare the results with those of competing higher education institutions. The summarized results, and the recommendations generated by the tool, allow managers to make informed decisions to improve the quality of services. The results of the experimental testing of the developed prototype of the software tool prove its applicability to support the HEIs leadership in making decisions for improving the quality of the offered educational services.

The conducted research also has some limitations. Since it has been tested with students from a small number of universities, it does not allow making general conclusions about the overall student satisfaction with the quality of educational and administrative services in higher education institutions.

In the future, the tool's functionalities will be expanded by:

- enriching the set of report templates with the results of conducted studies, including for comparative analysis across multiple HEIs, enabling institutions to benchmark their performance against others;

- extending the report generation capabilities to allow users to customize report templates, select specific data points, and choose visualizations for more tailored insights;

- improving the user interface and experience of the UQCS tool to make it more intuitive and user-friendly for both administrators and HEIs leadership;

- implementing data validation and cleaning mechanisms to ensure that the input data for evaluations is accurate and consistent, leading to more reliable results;

- integrating machine learning models to predict potential areas of improvement based on historical data and trends;

- strengthening the security aspects of the system, including encryption of sensitive data, role-based access

control, and secure communication with external servers;

- optimizing the software architecture to ensure scalability as more HEIs adopt the tool and the user base grows;

- implementing a feedback mechanism within the tool to collect user suggestions and experiences, driving continuous enhancements.

REFERENCES

[1] M. Brusoni, R. Damian, J. Sauri, S. Jackson, H. Kömürcügil, M. Malmedy & L. Zobel, The concept of excellence in higher education, 2006.

[2] H. Uiso, J. Magali, "Service quality variables for assessing students' satisfaction in higher learning institutions: evidence from empirical literature reviews," The Pan-African Journal of Business Management, 1(1): 2017, pp. 71-82

[3] A. Mastoi, L. XinHai & W. Saengkrod, "Higher education service quality based on students' satisfaction in Pakistan," European Scientific Journal ESJ, 75(11), 2019, pp. 32-62.

[4] J. Kivistö & E. Pekkola, Quality of administration in higher education, 2017.

[5] R. Emanuel & J. Adams, "Assessing college student perceptions of instructor customer service via the quality of instructor service to students (QISS) questionnaire," Assessment & Evaluation in Higher Education, 31(5), 2006, pp. 535-549.

[6] K. Hussain & C. Birol, "The assessment of non-academic and academic service quality in higher education, " Egitim Arastirmalari-Eurasian Journal of Educational Research, 42, 2011, pp. 95-116.

[7] S. Khoo & S. McGregor, "Service quality and student/customer satisfaction in the private tertiary education sector in Singapore," International Journal of Educational Management, 31(4), 2017, pp. 430-444.

[8] I. Mawudeku & F. J. Amkumah, "The Role of Administrators in Enhancing Students' Academic Performance in Higher Education Institutions," IOSR Journal of Humanities and Social Science (IOSR-JHSS) Volume, 26, 2021, pp. 16-22.

[9] P. Gupta & N. Kaushik, "Dimensions of service quality in higher education – critical review (students' perspective)," International Journal of Educational Management, 32(4), 2018, pp. 580-605.

[10] H.A. Al-Ababneh & S.A. Alrhaimi, "Modern approaches to education management to ensure the quality of educational services". TEM Journal, 9(2), 770, 2020.

[11] B. Lian and M. J. Putra, "The Role and Effectiveness of Education Administration in Developing Institutions of Higher Education in the Digital Era," 4th International Conference on Education and Social Science Research (ICESRE), KnE Social Sciences, 2022, pp. 592–602.

[12] M. Fakhrulnizam, R. Abdullah, M. A. Jabar, R. Nor Haizan, Nor Aida Abdul Rahman, "Towards The Integration of Quality Management System and Knowledge Management System In Higher Education Institution: Development Of Q-Edge Kms Model, " Acta Information Malaysia, 2(2), 2018, pp. 04-09.

[13] S. Đonlagić & S. Fazlić, "Quality assessment in higher education using the SERVQUALQ model, " Management: journal of contemporary management issues, 20(1), 2015, pp. 39-57.

[14] S. V. Veretekhina, V. A. Novikova, "Transformation of education in the digital economy, " Contemporary Problems of Social Work. Vol 5. № 2 (18), 2019, pp. 30-37.

[15] A. Zhang, G. Li, Z. Li, "Research on High Quality Development of Higher Education, " 5th International Conference on Humanities and Social Science Research (ICHSSR) Guilin, China. 319, 2019, pp. 472-475.

[16] J. L. Carcamo, "Factors associated with the teacher's practice that affect the dropout of students in the e-learning modality, a case study in the context of Chilean higher education, " CIENCIA E INGENIERIA. 42 (1), 2021, pp. 101-112.

[17] J.L. Gonzalez-Geraldo, F. Monroy, B. Del Rincon Igea, "Impact of a Spanish higher education teacher development programme on approaches to teaching, " Psychometric properties of the s-ati-20 scale. Educacion XXI. 24 (1), 2021, pp. 213-232.

[18] L. A. Rozak, M. Bahri Arifin, I.N. Rykova, O.A, Grishina, A. Komariah, D. Nurdin & O.V. Dudnik, "Empirical evaluation of educational service quality in the current higher education system," Emerging Science Journal, 6, 2022, pp. 55-77.

[19] N. Becket & M. Brookes, "Quality management practice in higher education - what quality are we actually enhancing?" Journal of Hospitality Leisure Sport and Tourism Education, 7(1), 2008, pp. 40-54.

[20] C.R. Santos, A.M. Contreras, C. Faúndez & G.F. Palomo-Vélez, "Adapting the SERVQUAL model to a physical activity break satisfaction scale, " International Journal of Workplace Health Management, 8(1), 2015, pp. 34-45.

[21] S. Sahney, "Use of multiple methodologies for developing a customer-oriented model of total quality management in higher education," International Journal of Educational Management, 30(3), 2016, pp. 3260-353.

[22] A. Moosavi, M. Mohseni, H. Ziaiifar, S. Azami-Aghdash, M.G. Manshadi & A. Rezapour, "The quality of educational services from students' viewpoint in Iran: a systematic review and meta-analysis," Iranian Journal of public health, 46(4), 2017, page 13.

[23] L.V. Krymets, O.H. Saienko, O.O. Bilyakovska, O.Y. Zakharov & D.H. Ivanova, "Methodology for Ensuring Quality Management of Higher Education," Revista geintec-gestao inovacao e tecnologias, 11(3), 2021, pp. 945-959.

[24] H. Kazeroony, The strategic management of higher education: Serving students as customers for institutional growth, USA: Business Expert Press, 2012.

[25] A. Bernhard, Quality assurance in an international higher education area: A case study approach and comparative analysis. Germany: Springer Fachmedien, 2012.

[26] J. Kettunen, J., "A conceptual framework to help evaluate the quality of institutional performance," Quality Assurance in Education 16(4), 2008, pp. 322–332.

[27] J. Kettunen, "Strategy and quality maps in higher education," US-China Education Review 8(2), 2011, pp. 149–156.

[28] I. Alnawas, "Student orientation in higher education: development of the construct," Higher Education, 69, 2015, pp. 625-652.

[29] U.S. Hoque, N. Akhter, N. Absar, M.U. Khandaker & A. Al-Mamun, "Assessing Service Quality Using SERVQUAL Model: An Empirical Study on Some Private Universities in Bangladesh," Trends in Higher Education, 2(1), 2023, pp. 255-269.

[30] M. Alifuddin, Reformasi Pendidikan: Strategi Informatif Peningkatan Mutu Pendidikan, Magna Script. Jakarta, 2012.

[31] A. Arokiasamy & A. Abdullah, "Service quality and students' satisfaction at higher learning institutions: A case study of Malaysian university competitiveness," International Journal of Management and Strategy, 3(5), 2012, pp. 1-16.

[32] H. Alves, M. Raposo, "The measurement of the construct satisfaction in higher education," Serv. Ind. J. 2009, 29, pp. 203–218.

[33] P. Stevens, "Dineserv: A tool for measuring service quality in restaurants," Cornell Hotel. Restaur. Adm. Q. 1995, 36, pp. 56–60.

[34] I.M. Tahir, "Importance-performance analysis of service quality among business students: An exploratory study," Interdiscip. J. Contemp. Res. Bus. 2010, 2, pp. 330–341.

[35] I. G. Lee, The Effect of Perception of Educational Service Quality on Re-Enrollment Intention and Word-of-Mouth Intention of College Students, Ph.D. Thesis, Busan, Republic of Korea, 2012.

[36] S. Annamdevula, R.S. Bellamkonda, "Effect of student perceived service quality on student satisfaction, loyalty and motivation in Indian university," J. Serv. Manag. 2016, 11, pp. 488–517.

[37] A. Burgess, C. Senior & E. Moores, "A 10-year case study on the changing determinants of University student satisfaction in the UK," Public 157 Library of Sciences (PLoS ONE), 13(2), 2018, pp. 1-15.

[38] R. Toghroli, F. Moradi, L. Hassani, T. Aghamolaei, N. Mehedi, F. Mahmoodi & B. Ziapour, "Evaluation of the educational services quality from the viewpoint of postgraduate students at Kermanshah University of medical sciences in 2019," Journal of Education and Health Promotion, 10. 2021.

[39] M. Khanli, H. Daneshmandi & A. Choobineh, "The students' viewpoint on the quality gap in educational services," Journal of advances in medical education & professionalism, 2(3), 114, 2014.

[40] F.M. Hill, "Managing service quality in higher education: the role of the student as primary consumer," Quality Assurance in Education, 3 (3), 1995, pp. 10-21.

[41] R. Barnett, "The marketized university: Defending the indefensible. In The Marketisation of Higher Education and the Student as Consumer," Molesworth, Routledge: Oxfordshire, UK, 2011; pp. 39–52.

[42] J.I. Yadav, "Service quality towards student satisfaction: An empirical investigation in selected management institutions of Sangli City," Ninth AIMS International Conference on Management, 2012.

[43] V. Okogbaa, "Quality in higher education: the need for feedback from students," Journal of Education and Practice, 7 (32), 2016, pp. 139-143.

[44] A. Rouf, M. Rahman and M. Uddin, "Students' satisfaction and service quality of HEIs," International Journal of Academic Research in Business and Social Sciences, 6(5), 2016, pp. 376-390.

[45] A. Azam, "Service quality dimensions and students' satisfaction: a study of Saudi Arabian private higher education institutions," European online journal of Natural and social sciences, 7(2), 2018, pp. 275-284.

[46] S. Lestari & K. Khusaini, Analysis of Student Satisfaction on Academic and Non Academic Administration, 2018.

[47] D. Napitupulu, R. Rahim, D. Abdullah, M.I. Setiawan, S. Abdillah, A.S. Ahmar, J. Simarmata, R. Hidayat, H. Nurdiyanto and A. Pranolo, "Analysis of student satisfaction toward quality of service facility," Journal of Physics: Conference. Series, 954(1), 2018, pp. 1-7.

[48] G. Prakash, "Quality in higher education institutions: insights from the literature," The TQM Journal, 23(3), 2018, pp. 250-261.

[49] J.L. Gregory, "Applying SERVQUAL: Using service quality perceptions to improve student satisfaction and program image," Journal of Applied Research in Higher Education, 11(4), 2019, pp. 788-799.

[50] H.L. Gao, "Understanding the impact of administrative service quality on satisfaction and loyalty towards university students." Higher Education Research, 5(1), 2020, pp. 25-30.

[51] I. Amoako & K. Asamoah-Gyimah, "Indicators of students' satisfaction of quality education services in some selected universities in Ghana," South African Journal of Higher Education, 34(5), 2020, pp. 61-72.

[52] P. Kaur & K. Amanpreet, "Service quality in higher education: a literature review," Elementary Education Online, 19(40), 2020, pp. 6308-6324.

[53] A. Kara and O. DeShields. Business student satisfaction, intentions and retention in higher education: An empirical investigation. http://www.marketingpower.com/Community/ARC/gated/Documents/Teaching/MEO/ student_satisfaction.pdf, 2004.

[54] J. Douglas, A. Douglas,B. Barnes. "Measuring student satisfaction at a UK university," Quality Assurance in Education 14(3), 2006, pp. 251–267.

[55] H. Encabo, "Canonical correlation analysis of student perception on instructional quality and satisfaction," JPAIR Multidisciplinary Journal 6, 2011, pp. 1–16.

[56] R. Prasad & M. Jha, "Quality measures in higher education: A review and conceptual model," Quest Journals Journal of Research in Business and Management, 1(3), 2013, pp. 23 – 40.

[57] C. Taib, A. Warokka & H. Hilman, "The library's quality management system and quality assurance in higher education: A lesson from Southeast emerging educational hub," Communications of the IBIMA, 2012, pp. 1-11.

[58] V. Mahmood, M. Dangi & K. Ali, "Exploring students' contentment level of the infrastructure at a public higher education institution in Malaysia," Gading Business and Management Journal, 18(1), 2014, pp. 61-82.

[59] R. Arambewela and J. Hall, "An empirical model of international student satisfaction," Asian Pacific Journal of Marketing and Logistics 21(4), 2009, pp. 555–569.

[60] E. Razinkina, I. Pankova, E. Trostinskaya, L. Pozdeeva Evseeva and A. Tanova, "Student satisfaction as an element of education quality monitoring in innovative higher education institution," E3S Web of Conferences, 33, 03043. 2018.

[61] A. Osman and R. Saputra, "A pragmatic model of student satisfaction: A viewpoint of private higher education," Quality Assurance in Education 27(2), 2019, pp. 142–165.

[62] S. Muhsin, A. Nurkhin, H. Pramusinto, N. Afsari and A. F. Arham. "The relationship of good university governance and student satisfaction," International Journal of Higher Education 9(1), 2020.

[63] N. Tuan, "Effects of service quality and price fairness on student satisfaction," International Journal of Business and Social Science 3(19), 2012, pp. 132–150.

[64] P. Sultan and H.Y. Wong, "Antecedents and consequences of service quality in a higher education context: A qualitative research approach," Quality Assurance in Education, 21(1), 2013, pp. 70-95.

[65] Y. Stukalina, "Identifying predictors of student satisfaction and student motivation in the framework of assuring quality in the delivery of higher education services," Business, Management and Education 12(1), 2014, pp. 127–137.

[66] A. Kara, E. Tanui & J. Kalai, Quality of academic resources and students' satisfaction in public universities in Kenya, 2016.

[67] M. Vinogradova, O. Kulyamina, L. Vasileva, E. Bronnikova & V. Vishnyakova, "Methodology for assessing the quality of educational services in higher education," Revista on line de Política e Gestão Educacional, 2021.

[68] W.E. Deming, Out of the crisis. MIT Centre for Advanced Engineering Study, 1986.

[69] A. Weckenmann, G. Akkasoglu & T. Werner, "Quality management – history and Trends," The TQM Journal, 27(3), 2015, pp. 281–293.

[70] E. Psomas & J. Antony, "Total quality management elements and results in higher education institutions: The Greek case," Quality Assurance in Education, 25(2), 2018, pp. 206-223.

[71] F. Cruz, I. Gálvez & R. Santaolalla, "Impact of quality management systems on teaching-learning processes," Quality Assurance in Education, 24(3), 2016, pp. 394-415.

[72] N. Bouranta, E. Psomas & J. Antony, "Findings of quality management studies in primary and secondary education: A systematic literature review," The TQM Journal, 33(3), 2021, pp. 729-769.

[73] E. Sfakianaki, "A measurement instrument for implementing total quality management in Greek primary and secondary education," International Journal of Educational Management, 33(5), 2019, pp. 1065-1081.

[74] V.M. Sunder, "Constructs of quality in higher education services," International Journal of Productivity and Performance Management, 65(8), 2016, pp. 1091-1111.

[75] N. Mehta, P. Verma & N. Seth, "Total quality management implementation in engineering education in India: An interpretive structural modelling approach," Total Quality Management & Business Excellence, 25(1-2), 2014, pp. 124-140.

[76] C. Grönroos, "A service quality model and its marketing implications. European Journal of Marketing", Vol. 18, No. 4, 1984, pp. 36-44.

[77] A. Parasuraman, V.A. Zeithaml & L.L. Berry, "SERVQUAL: a multiple-item scale for measuring consumer perceptions of service quality," Journal of Retailing, 64(1), 1988, pp. 12-40.

[78] J.J. Cronin & S.A. Taylor, "SERVPERF versus SERVQUAL: Reconciling performance-based and perceptions minus-expectations

measurement of service quality," Journal of Marketing, 58(1), 1992, pp. 125-131.

[79] H.W. Marsh, "SEEQ: A reliable, valid and useful instrument for collecting students' evaluations of university teaching," British Journal of Educational Psychology, 52(1), 1982, pp. 77-95.

[80] H.W. Marsh, "Students' evaluations of university teaching: Research findings, methodological issues, and directions for further research," Journal of Educational Research, 11(3), 1987, pp. 253-388.

[81] A. Parasuraman, V.A. Zeithaml & L.L. Berry, "A conceptual model of service quality and its implication. Journal of Marketing, 49, 1985, 41-50.

[82] R. Narang, "How do management students perceive the quality of education in public institutions?" Quality Assurance in Education, 20(4), 2012.

[83] M.A. Adil, O.F. Ghaswyneh and A.M. Albkour "SERVQUAL and SERVPERF: a review of measures in services marketing research," Global Journal of Management and Business Research Marketing, 13(6), 2013, pp. 65-76.

[84] H.M. Awoke, "Service quality and consumer satisfaction: Empirical evidence from saving account consumers of the banking industry," European Journal of Business and Management, 7(1), 2015, pp. 144-164.

[85] K. Randheer, "Service quality performance scale in higher education: culture as a new dimension," International Business Research, 8(3), 2015, pp. 29-41.

[86] R. Galeeva, "SERVQUAL application and adaptation for educational service quality assessments in Russian higher education," Quality Assurance in Education, 24(3), 2016, pp. 329-348.

[87] P. Jain and V.S. Aggarwal, "Service quality models: a review," BVIMSR's Journal of Management Research, 7 (2), 2015, pp. 125-136.

[88] E.O. Onditi and T.W. Wechuli, "Service quality and student satisfaction in higher education institutions: a review of the literature," International Journal of Scientific and Research Publications, 7(7), 2017, pp. 328-335.

[89] F. Khattab "Developing a service quality model for private higher education institutions in Lebanon," Journal of Management and Marketing Review, 3(1), 2018, pp. 24-33.

[90] N. Ramya, A. Kowsalya and K. Dharanipriya, "Service quality and its dimensions," EPRA International Journal of Research and Development (IJRD), 4(2), 2019, pp. 38-41.

[91] K.C. Tan, S.W. Kek, "Service quality in Higher education using and enhanced SERVQUAL approach," Quality in Higher education, 10 (1), 2004, pp. 17-24.

[92] J. Dado, J. Taborecka-Petrovicova, D. Riznic & T. Rajic, "An empirical investigation into the construct of higher education service quality," International Review of Management and Marketing, 1(3), 2011, pp. 30-42.

[93] M. Javadi, Quality Assessment for Academic Services in University of Isfahan According to the Student's Opinion Using SERVQUAL. Model Interdisciplinary Journal of Contemporary Research in Business. Vol. 3 Edisi 4, 2011.

[94] J. Legcevic, N. Mujic & M. Mikrut, "Kvalimetar mjerni instrument za upravljanje kvalitetom na Sveučilištu u Osijeku," Internation scientific symposium "quality and social responsibility". In Croatian Association of Quality Managers, 2012, pp. 271–283.

[95] C.E. Nell and M.C. Cant, "SERVQUAL: Student's perception and satisfaction regarding the quality of service provided by student administration departments within tertiary institutions," Corporate Ownership & Control, 11(4), 2014, pp. 242-249.

[96] P. Green, "Measuring service quality in higher education: A South African case study," Journal of International Education Research, 10(2), 2014, pp. 131 - 142.

[97] S. Anwowie, J. Amoako and A. Abrefa, "Assessment of students' satisfaction of service quality in Takoradi Polytechnic: the students' perspective, Journal of Education and Practice, 6 (29), 2015, pp. 148-155.

[98] V. Teeroovengadum, T.J. Kamalanabhan & A.K. Seebaluck, "Measuring service quality in higher education: Development of a hierarchical model

(HESQUAL),"Quality Assurance in Education, 24(2), 2016, pp. 244-258.

[99] K.F. Latif, I. Latif, U.F. Sahibzada, M. Ullah, "In search of quality: measuring higher education service quality (HiEduQual)," Total Quality Management & Business Excellence, 2017, pp. 1 – 24.

[100] A. Nsamba and M. Makoe, "Evaluating quality of students' support services in open distance learning," Journal of Distance Education, 18(4), 2017, pp. 91 – 103.

[101] M. Saleem, A. Hussain and S. Ahmad, "Identification of gaps in service quality in higher education," Bulletin of Education and Research, 39 (2), 2017, pp. 171 – 182.

[102] A.S. Williams, An exploratory study of students' expectations and perceptions of service quality in a South African higher education institution. M.Tech., Rhodes University, 2018.

[103] R. Rezaee, Z. Yazdani, Z., Zahedani & N. Zarifsanaiey, "Quality of educational services: students' point of view," Journal of Advanced Pharmacy Education & Research, 8(S2), 163, 2018.

[104] L. Neyra, E. Espinoza & A. Ramírez, "Quality of educational service at the Faculty of Social Sciences and Humanities of a Public University," Educação & Formação, 6(3), 2021.

[105] S. Daryazadeh, M. Yavari, M. Sharif, M. Azadchahr, S. Hoseini & H. Akbari, "Assessing the Quality of Educational Services from the Viewpoint of Clinical Teachers and Medical Students Using SERVQUAL Model," Educational Research in Medical Sciences, 11(2), 2022.

[106] T. Aghamolaei, S. Zare, "Quality gap of educational services in viewpoints of students in Hormozgan University of medical sciences," BMC medical education, 8(1), 2008, pp. 1-6.

[107] C. Zafiropoulos & V. Vrana, "Service Quality Assessment in a Greek Higher Education Institute," Journal of Business Economics and Management, 9 (1), 2008, pp. 33-45.

[108] G. Icli & N. Anil, "The HEDQUAL scale: A new measurement scale of service quality for MBA programs in higher education," South African Journal of Business Management, 45(3), 2014, pp. 31-43.

[109] Z. Hassan, A. Raheem, M. Yusof, "Educational Service Quality at Public Higher Educational Institutions: Difference between Perceived Service and Expected Service," Journal of Economics, Business and Management, Vol. 3, No. 11, 2015.

[110] A. Guillén Perales, F. Liébana-Cabanillas, J. Sánchez-Fernández & L.J. Herrera, "Assessing university students' perception of academic quality using machine learning," Applied Computing and Informatics. 2020.

[111] S. Rizos, E. Sfakianaki & A. Kakouris, "Quality of administrative services in higher education," European Journal of Educational Management, 5(2), 2022, pp. 115-128.

[112] B. Ganbold, K. Park, J. Hong, Study of Educational Service Quality in Mongolian Universities. Sustainability 2023, 15, 580, 2023.

[113] J. Abalo, J. Varela & V. Manzano, "Importance values for Importance–Performance Analysis: A formula for spreading out values derived from preference rankings," Journal of Business Research, 60(2), 2007, pp. 115-121.

[114] I. Sever, "Importance-performance analysis: A valid management tool? Tourism Management, 48, 2015, pp. 43-53.

[115] F. Pai, T. Yeh & C. Tang, "Classifying restaurant service quality attributes by using Kano model and IPA approach," Total Quality Management & Business Excellence, 29(3-4), 2016, pp. 301–328.

[116] R. Dabestani, A. Shahin, M. Saljoughian & H. Shirouyehzad, "Importance performance analysis of service quality dimensions for the customer groups segmented by DEA," International Journal of Quality & Reliability Management, 33(2), 2016, pp. 160-177.

[117] N. Slack, N. "The importance-performance matrix as a determinant of improvement priority," International Journal of Operations & Production Management, 14(5), 1994, pp. 59-75.

[118] M. Joseph & B. Joseph, "Service quality in education: a student perspective. Quality Assurance in Education, 5(1), 1997, pp. 15–21.

[119] K. Matzler, F. Bailom, H. Hinterhuber, B. Renzl & J. Pichler, "The asymmetric relationship between attribute-level performance and overall customer satisfaction: a reconsideration of the importance–performance analysis," Industrial marketing management, 33(4), 2004, pp. 271-277.

[120] M. Feng, J. Mangan, C. Wong, M. Xu & C. Lalwani, "Investigating the different approaches to importance–performance analysis," The Service Industries Journal, 34(12), 2014, pp. 1021-1041.

[121] S. Ormanovic, A. Ciric, M. Talovic, H. Alic, J. Eldin & D. Causevic, "ImportancePerformance Analysis: Different Approaches," Acta Kinesiologica, 11(2), 2017.

[122] J.M. Carman, "Consumer perceptions of service quality: an assessment of the SERVQUAL dimensions. Journal of Retailing, 66(1), 1990, 33-55.

[123] C. Grönroos, "Toward a third phase in service quality research," Advances in Services Marketing and Management: Research and Practice, 2, 1993, pp. 49-64.

[124] R. Bolton & J. Drew, "A multi-stage model of customers' assessments of service quality and value," Journal of Consumer Research, 17, 1991, pp. 375-84.

[125] F. Abdullah, "Measuring service quality in higher education: HEdPERF versus SERVPERF." Marketing Intelligence and Planning, 24(1), 2006. pp. 31-47.

[126] K. Brunson, "Examining the Need for Customized Satisfaction Survey Instruments for Measuring Brand Loyalty for Higher Educational Institutions," Liberty University School of Business Journal, 2010, 1-22.

[127] N. Shaik, S. Lowe, K. Pinegar, "DL-sQUAL: A multiple-item scale for measuring service quality of online distance learning programs", Online Journal of Distance Learning Administration, IX(II), 2006.

[128] M. Calatrava Moreno, Towards a Flexible Assessment of Higher Education with 360-degree Feedback, Information Technology Based Higher Education and Training (ITHET), 2013.

[129] D. Tee, P. Ahmed, "360 degree feedback: an integrative framework for learning and assessment," Teaching in Higher Education, Vol. 19, Issue 6, 2014.

[130] L. Harvey & D. Green, "Defining quality. Assessment and Evaluation in Higher Education," 18(1), 1993, pp. 9–34.

[131] L. Vnoučková, H. Urbancová, H. Smolová, "Internal quality process management evaluation in higher education by students", DANUBE: Law, Economics and Social Issues Review, ISSN 1804-8285, De Gruyter, Warsaw, Vol. 9, Iss. 2, 2018, pp. 63-80.

[132] W. Prima & R. Saputra, "Designing an information system model of academic service based on customer relationship management at university, " In Journal of Physics: Conference Series (Vol. 1387, No. 1, p. 012009). IOP Publishing, 2019.

[133] V. Zeithaml, M. Bitner, and D. Gremler, Services Marketing: Integrating Customer Focus Across the Firm. McGraw-Hill Education, 2017.

[134] C.T. Montemayor, "Innovation and Quality Management in Higher Education," PalArch's Journal of Archaeology of Egypt/Egyptology, 17(9), 2020, pp. 1559-1579.

[135] H. Tran, M. Nguyen, T. Nguyen, H. Tran, "Students Satisfaction with Public Services in Higher Education Institutions: The Case of Vietnam," Specialusis Ugdymas, 1(43), 2022, pp. 1021-1046.

[136] N.C. Hai, "Factors Affecting Student Satisfaction with Higher Education Service Quality in Vietnam," European Journal of Educational Research, 11(1), 2022, pp. 339-351.

[137] F. Assiri, Utilizing E-administration to Improve the Quality of Educational Services at Saudi Universities During COVID-19, 2023.

[138] M. Lubis, M. Hasibuan & R. Andreswari, " Satisfaction Measurement in the Blended Learning System of the University: The Literacy Mediated-Discourses (LM-D) Framework," Sustainability, 14(19), 12929, 2022.

[139] L. Grebennikov & M. Shah, "Monitoring trends in student satisfaction," Tertiary Education and Management, 19, 2013, pp. 301-322.