Examination of methods for assessing educational quality, the role of standardisation, and mechanisms for enhancing educational programme efficiency

Tetiana Motuz* | Anna Dynovych* | Olha Babelchuk* | Svitlana Bykasova* | Dmytro Gulevets*

*Department of General and Special Pedagogy, Communal Institution of Higher Education “Dnipro Academy of Continuing Education” of Dnipropetrovsk Regional Council, Dnipro, Ukraine.
*Department of General Pedagogy and Preschool Education, Faculty of History, Pedagogy and Psychology, Drohobych Ivan Franko State Pedagogical University, Drohobych, Ukraine.
*Department of Pedagogy, Psychology, Primary Education and Educational Management, Psychological and Pedagogical Faculty, Municipal Establishment “Kharkiv Humanitarian-Pedagogical Academy” of Kharkiv Regional Council, Kharkiv, Ukraine.
*Department of Theory and Methods of Preschool Education, Municipal Establishment “Kharkiv Humanitarian-Pedagogical Academy” of Kharkiv Regional Council, Kharkiv, Ukraine.
*Institute of Security, Interregional Academy of Personnel Management, Kyiv, Ukraine.

Abstract The academic paper is devoted to studying the methods of assessing the quality of education and the role of standardization in this process. Particular attention is paid to the mechanisms for improving the effectiveness of educational programs in the modern educational environment. The paper considers the importance of standardization as a tool for improving curricula and identifies key mechanisms aimed at improving the efficiency of the educational process. The research findings can be useful for governing bodies, higher educational institutions, teachers and researchers, contributing to the improvement of the education system and ensuring its high quality. The authors explore innovative approaches and strategies that can be applied to optimize the training process, ensuring more efficient use of educational resources and improving the quality of students’ knowledge. The vector model for analyzing the text of educational programs for compliance with the standard of higher education for a particular specialty is presented. Using the static and variation analysis, the reliability of the data obtained has been established. The research results can be useful for practicing teachers, administrators and policy makers in the field of education seeking to improve the effectiveness of educational programs and guarantee a high standard of education.

Keywords: educational program, standard of higher education, criteria for the quality of educational programs, cluster analysis, state governance

1. Introduction

The issue of assessing the quality of education, implementing standards and improving teaching methods is becoming extremely relevant in the conditions of constant changes in the modern educational environment. While technological, sociocultural and economic shifts are rapidly transforming the learning paradigm, the study of methods for assessing the quality of education is becoming a critical task to ensure a high level of training and preparation of students for the challenges of the modern world. The present academic paper aims to provide a thorough analysis of assessment methods, focusing on the role of standardization as a key element in the process of ensuring the quality of education (Antoshkina et al., 2023). The authors aim to reveal the mechanisms that contribute to the effectiveness of educational programs in response to the modern requirements of the educational environment by exploring the interconnection between assessment and standards. The academic paper presents an in-depth review of instruments and strategies that will assist in optimizing the learning process and improve the quality of educational programs in the modern world, demonstrating the significance of this topic for the development of educational systems. Ukraine’s system of higher education plays a key role in national development, although its management requires permanent improvement. International experience is a crucial consideration when creating educational programs, in addition to the requirements of higher education for a particular specialty (Bondar et al., 2023). The Administration of Higher Education in Ukraine focuses its activities on creating a favorable climate for the development of academic freedom, supporting innovation and ensuring high quality education. In particular, the management system aims to create conditions contributing to the free expression of ideas, research and creativity in the environment of higher educational institutions. Modern requirements for
managing higher education determine the need for dynamism, predictability and readiness to respond quickly to changes in the external environment. Management should be flexible and adaptive, able to effectively implement innovative strategies and solutions in order to support the educational process and improve its quality (Dubaseniuk et al., 2023). One of the key tasks of the mechanisms of state governance of higher education is to ensure not only freedom of expression of academic views but also to stimulate innovative development (Hasiuk, 2022). This may include developing and implementing the latest teaching methods, supporting research activities and providing access to modern technologies. Such an approach to managing higher education creates the preconditions for creating a competitive educational environment that meets modern challenges and promotes the qualitative growth of students’ competencies.

The ability to function effectively in the face of war, European integration and modern challenges requires the higher education system to be flexible, robust and dynamic. Adaptation, compliance with European standards, the use of technologies, and international cooperation can help address these challenges, contributing to improving the quality of education and making it more attractive to students and teachers (Khoi, 2022). The present academic paper will consider the methods of assessing the quality of education, the role of standardization in the development of educational programs, and the mechanisms that contribute to the effectiveness of educational programs. Studying these aspects will make it possible to identify current trends and improve approaches to creating effective strategies for the development of education. By addressing these issues, we will highlight the key challenges facing the modern educational system and propose ways to address these issues to ensure high-quality and relevant education.

2. Literature Review

The current standards of higher education in Ukraine (SHEU) for the specialty 101 “Ecology” at the bachelor’s and master’s levels, and educational and scientific levels are based on the list of graduate competencies (Mukhamedov et al., 2020). These competencies cover a wide range of knowledge, skills, experience and other personal qualities that determine learning outcomes (Gaalen et al., 2021). The integral competence for different levels of higher education is established in accordance with the National Qualifications Framework of Ukraine, which consists of 8 levels. The standard for the bachelor’s degree provides 13 special competencies; the standard for the master’s degree – 10 special competencies, and for the doctorate – 6 ones. These competencies reflect the basic knowledge and practical skills that were originally included in the list of mandatory (normative) disciplines in previous standards. It should be noted that the current Standards of Higher Education of Ukraine do not contain specific recommendations on the names of academic disciplines, the number of credits, structure and content, and the sequence of their teaching. This creates flexibility in the formation of educational programs and promotes the development of individual learning paths; however, it may also require clarification and harmonization to ensure a standardized approach to learning at different levels of higher education. Therefore, it is important to focus on the essence of the competencies specified in the new SHEU, and, at the same time, preserve the existing disciplines. Moreover, one should take into account the available educational and methodological base for training environmental specialists that has been established in previous years (Dubaseniuk et al., 2020). The main idea of the competency-based approach is that the competencies cannot be directly assessed. The new Standards of Higher Education of Ukraine (SHEU) have developed a system of programmatic learning outcomes, which acts as a link between a specific academic discipline and the competencies that a graduate should possess.

Program learning outcomes are formulated to allow for direct identification of achievement or non-achievement, as well as to measure the level of comprehension of complex outcomes (Kremen et al., 2022). It should be emphasized that the SHEU are characterized by the collective principle, where a single competence is formed through the achievement of several program outcomes, and vice versa – one program outcome may reflect the achievement of several competencies. This establishes an interconnection between academic disciplines, ensuring the integration of competencies and the formation of a holistic system of the graduate’s qualities in a particular subject area (Zagirnyak et al., 2020). The academic discipline does not exist separately; it is integrated into the interdisciplinary structural and logical scheme of training a specialist. Based on this scheme, the disciplines interact and interconnect, contributing to the comprehensive formation of students’ knowledge and skills (Holomb, 2022). Educational programs, in turn, are developed on the basis of standards of higher education, which serve as the framework for ensuring quality training of specialists. These standards define the key competencies and requirements that educational programs must meet in order to provide graduates with the necessary knowledge and skills to be successful in their chosen field. Standards of higher education define the basic requirements for the content, structure, quality and organization of the educational process in higher educational institutions (Hasiuk, 2022). These standards serve as the basis for the development of educational programs and aim to ensure a high level of educational quality and define common standardized criteria for assessing students’ knowledge and skills at different levels of higher education. The major features of the standards of higher education include as follows (Zagorodnya et al., 2020):

**Competency-based approach:** Modern standards of higher education are often based on a competency-based approach. They define what specific competencies a student should acquire during his studies and how this will be assessed.

**Structure of educational levels:** The standards identify different levels of higher education, such as bachelor’s, master’s and doctoral degrees. Each level has its own unique requirements for the student’s knowledge, skills and level of independence.

**Number of credits:** The number of credits is determined (for instance, according to the European Credit Transfer and Accumulation System – ECTS) that a student must successfully complete to obtain each educational level.
Content of training: Standards define the basic and specialized knowledge that a student should acquire in the framework of his specialty or program.

Assessment process: Methods and criteria for evaluating students, their participation in internships, exams and diploma papers are defined.

Mobility of students: Standards often take into account the possibility of students’ mobility, their participation in exchange programs, internships or double degrees (Tursunalievich and Rahmat, 2021).

Language of instruction: The main language of training is indicated as well as requirements for foreign language proficiency.

Standards of higher education are a key tool for ensuring the quality of education; their implementation helps unify and improve the level of education in different countries and higher educational institutions. Higher educational institutions have the opportunity to design and implement educational programs in the framework of the specialties for which they have received a license (Docent, 2020). At the same time, they are advised to be guided by the methodological recommendations and a sample of educational programs provided by the Ministry of Education and Science of Ukraine. Providing graduates with all the competencies defined by the standards is a key goal of the system of the program’s educational components. Developers of educational programs are entitled to expand the list of competencies, taking into account the chosen specialization and the specifics of a particular educational institution (Shahjahan et al., 2022; Antoshkina et al., 2023). According to the Standards of Higher Education of Ukraine (SHEU) for a bachelor’s degree, at least 50% of the educational program should be aimed at developing general and special (professional) competencies. It is important to recognize that the competencies defined by the SHEU do not necessarily have to be formed only while studying compulsory disciplines (Shahjahan et al., 2022).

The variable part of the curriculum can also contribute to the development of these competencies; additional programmatic learning outcomes can be defined if necessary. All this should be recorded in the educational program and explanatory note to the curriculum. The explanatory note to the curriculum reflects the logical interconnection between competencies, and the program’s learning outcomes and the names of academic disciplines and practices (Luniacheh et al., 2020). Taking into account the absence of recommendations on the names of disciplines in the SHEU, developers can use the existing educational and methodological base, in particular, adapt existing disciplines to the defined competencies in the standard for the first (bachelor’s) level. In the case of the second level of higher education, for example, for the specialty 101 “Ecology”, the SHEU also lacks recommendations on the names of the disciplines required to provide competencies. It is worthwhile to use a similar strategy and compare the special competencies of the standard with the list of existing disciplines of the master’s program in ecology (Lokarieva and Chorna, 2022). Therefore, when developing educational programs, it is reasonable to use the existing educational and methodological base, especially when determining the compliance of the content of existing academic disciplines with the standard’s established competencies. Nevertheless, it is important to note that it can be challenging to establish the relevance of the general competencies of the standard to individual disciplines. For instance, although there is a clear correspondence between the competence “Ability to communicate in a foreign language” and the discipline “Foreign language for professional purposes”, these competencies are not limited to mastering only this discipline (Nahursky et al., 2022).

Some general competencies, such as “The ability to conduct research at the relevant level”, also cannot be fully encompassed by a single discipline, for example, “Methodology and organization of scientific research” (for OSR). It is noted that these general competencies are acquired throughout the entire training and throughout students’ lives. Taking into account the experience of training masters in the field of ecology, Odesa State Environmental University (OSEU) has developed a number of educational and professional programs (EPP) and educational and scientific programs (ESP) for the specialty 101 “Ecology”, such as “Agroecology”, “Hydroecology”, “Ecology and Environmental Protection”, “Environmental Control and Audit”, “Environmental Safety”. These programs take into account the professional competencies of the corresponding SHEU to the maximum extent possible; there is a matrix of the correlation between competencies and learning outcomes, as well as a list of compulsory and elective educational components. The competencies of the standards of the first (bachelor’s) and second (master’s) levels of higher education are indicated when defining the syllabuses of individual educational components by each academic discipline. At the same time, the development of the standard for the third (doctoral) level of higher education in the field of ecology is more difficult since it is only the first attempt, and there are some difficulties in defining the content and outcomes of the educational and scientific program (Morze et al., 2021; Buryk, 2018).

The establishment of an expert environment for assessing the quality of higher education has always been relevant in the history of independent Ukraine. In order to carry out the examination of curricula in the country, the need arose to form a group of experts, which would include teachers and students who would be willing to join the process of reforming higher education in Ukraine to improve its quality (Oseredchuk et al., 2022). It was also an opportunity to retrain those who had already passed the exams before but had experience only in formal expertise. This process’ main goal was to draw in a wide range of viewpoints so that numerous perspectives might be considered when evaluating the quality of education (Khovrak, 2020). Such an expert environment contributed to the creation of objective criteria and recommendations for improving educational programs, as well as ensured interaction between pedagogical specialists and students who felt responsible for the quality of education in Ukraine (Zagorodnya et al., 2020; Kryshtanovych et al., 2022). This approach to the formation of an
expert environment contributed not only to enhancing the quality of higher education, but also stimulated the ongoing improvement of educational standards and teaching methods in line with the requirements of the modern world.

3. Methods

Diverse approaches and methods can be used to transform textual information into numerical data when solving tasks of linguistic text analysis. Automatic linguistic analysis requires the use of relevant tools and methods.

The algorithm for constructing a vector model can be represented by a sequence of stages:

**Preliminary text processing:** All images, tables, sentences with formulas, as well as information about authors and bibliographic references are removed at this stage. The only thing that remains is the thematic content of the document.

**Conversion of the text:** Filtration of “stop words”, special characters, and numbers is performed. The text is converted into a “bag of words”.

**External assessment of document features:** It is determined whether the document corresponds to a certain competency using a vector model.

The application of the vector model makes it possible to search and rank documents by their similarity in the vector space. The process of document indexing includes the extraction of terms, weighting of terms, and reduction of the dimensionality of the vector space.

**Removal of terms:** The methods are used to search for and select relevant terms in the corpus of documents.

**Lexical analysis:** This stage includes the removal of non-alphabetic symbols, such as punctuation marks, numbers, etc.

**Removing stop words:** Words without a significant semantic load (stop words) are not taken into account to reduce the dimensionality of the vector space.

**Lemmatization and roots:** The reduction of each word to its normal form is performed by means of lemmatization and leakage.

These stages are aimed at generating a weight vector for the document used for further processing and analysis.

All the terms contained in the processed texts (including taxonomic terms) are added to a single set after processing, which does not contain repeated words. This set is usually called a “bag of words”. Let’s assume that \(|T| = n\). Let’s describe the model for creating an educational program that meets the defined competencies. The formulation of the problem can be stated as follows: Let’s assume that there is a collection of syllabuses \(D = \{d_1, d_2, \ldots, d_n\}\) and a glossary of terms \(T = \{t_1, t_2, \ldots, t_m\}\) from the base of competencies that interacts with the user’s question. Let’s take a look at a document from the collection of syllabuses \(d_i \in D\) and represent it as a vector from the space \(\mathbb{R}^n\):

\[
d_i = [t_{f_1}, t_{f_2}, \ldots, t_{f_m}],
\]

where \(t_{f_i}\) – is the number under which the word appears in the document. In the vector model, a document is considered as an unordered set of elements.

In the basic vector model developed by Salton, Wong, and Yang, certain measures are used for each word in the document, which are defined as the product of local and global parameters. This model is also known as the tf-idf model. The mass of a vector for a particular document is determined as follows:

\[
v_d = [w_{1,d}, w_{2,d}, \ldots, w_{N,d}]^T,
\]

Where

\[
w_{t,d} = t_{f,t,d} \cdot \log \frac{|D|}{|d \in D| \cap |t \in d|}
\]

and \(t_{f,t,d}\) is the frequency of term \(t\) in document \(d\) (local parameter). \(\log \frac{|D|}{|d \in D| \cap |t \in d|}\) is the inverse frequency of the document (global parameter). \(|D|\) - is the total number of documents in the set of documents; \(|d \in D| \cap |t \in d|\) - is the number of documents containing the term \(t\). Using cosine similarity, the similarity between a document \(d_j\) and a query \(q\) can be calculated as follows:

\[
sim(d_j, q) = \frac{d_j \cdot q}{\|d_j\| \cdot \|q\|} = \frac{\sum_{i=1}^{N} w_{j,i}w_{i,q}}{\sqrt{\sum_{i=1}^{N} w_{j,i}^2} \sqrt{\sum_{i=1}^{N} w_{i,q}^2}}
\]

According to the structure of many clusters, clustering algorithms can generate flat or hierarchical clustering. Hierarchical clustering implies the presence of nested clusters in the form of a tree. The advantage of hierarchical clustering over flat algorithms is the ability to obtain more information about the selection of documents and the ability to consider different levels of thematic organization of the collection (Kharlamova et al., 2021). Classical approaches to constructing hierarchical clustering are agglomerative and divisive clustering algorithms. In hierarchical clustering, objects are gradually combined into larger clusters using agglomerative algorithms (Sikra, 2022). Thus, one cluster containing all objects is obtained from the configuration when each object is a separate cluster. On the other hand, smaller clusters are obtained from larger
clusters by using division algorithms. At the same time, clusters of individual objects are obtained from a single cluster that contains all objects in the sample. When constructing clustering using the agglomerative method, the object is initially considered as a separate cluster. For single clusters, the distance is determined according to the formula:

\[ R((x), (x')) = p(x, x') \quad (5) \]

During the iteration, a new cluster \( W \) is created, which is the union of clusters \( U \) and \( V \), instead of choosing two of the closest clusters, \( U \) and \( V \). The distance from this new cluster \( W \) to any other cluster \( S \) is calculated on the basis of the previously calculated distances \( R(U, V), R(U, S) \) and \( R(V, S) \):

\[
R(U \cup V, S) = \alpha_U R(U, S) + \alpha_V R(V, S) + \beta R(U, V) + \gamma |R(U, S) - R(V, S)| \quad (6)
\]

where \( \alpha_U, \alpha_V, \beta, \gamma \) are parameters of the model. A universal method for calculating inter-cluster distances is used to determine the distances between different clusters during clustering. There are various approaches to measuring the distances \( R(W, S) \) between clusters \( W \) and \( S \), and for each of them the Lance-Williams formula has been confirmed for certain parameters. The studies conducted in (Chen et al., 2021; Fettach et al., 2024), which examined the algorithms for agglomerative and divisional text clustering, showed that the average distance is the most optimal metric for agglomerative methods. It is the average distance that is calculated using a specific formula that takes into account the distances between cluster objects.

\[
R(W, S) = \frac{1}{|W||S|} \sum_{w \in W} \sum_{s \in S} p(w, s) \quad (7)
\]

\[
\alpha_U = \frac{|U|}{|W|}, \alpha_V = \frac{|V|}{|W|}, \beta = \gamma = 0
\]

This method calculates the average distance between all pairs of objects in two separate clusters to determine their distance from each other. We applied the scipy library to implement this model. We also used the Statistica 7 program.

4. Results

Cluster analysis of documents was used to determine the group of educational programs characterized by common features as well as to reveal groups of similar educational programs in the sample. The cluster method is a multivariate statistical procedure that collects data containing information about a sample of objects and then organizes the objects into sufficiently homogenous groups. The selection of objects for assessing the quality of the educational program included the formation of a vector of keywords from the database of professional competencies selected by the user. The selection was based on the questions as follows:

SQL code is a series of queries for a relational database. Queries look like SQL statements to retrieve specific data from a database. The code snippet below is in Python:

- Select all directions;
- SELECT name FROM directions;
- Select the ID of the direction with the name 'ESP code';
- SELECT id FROM directions WHERE name = 'ESP code';
- Select all professions for a particular direction (by ID of the direction);
- SELECT name FROM professions WHERE direct_id=1;
- Select the ID of the profession with the name 'Guarantor of the ESP';
- SELECT id FROM professions WHERE name='Guarantor of the ESP';
- Select all functions for a particular profession (by ID of the ESP);
- SELECT name FROM functions WHERE prof_id=7;
- Select the ID of the function named 'Preparation for the development of an educational and scientific program';
- SELECT id FROM functions WHERE name='Preparation for the development of an educational and scientific program';
- Select all tasks for a specific function (by ID of the function);
- SELECT name FROM tasks WHERE func_id=8;
- Select the ID of the task with the name 'Analysis of requirements for the educational and scientific program';
- SELECT id FROM tasks WHERE name='Analysis of requirements for the educational and scientific program';
- Select all knowledge for a particular task (by ID of the task);
- SELECT name FROM knowledges WHERE task_id=10;
- Eight ESPs accredited in 2022 were analyzed in this research.

The results of assessing the compliance of educational programs with quality criteria are presented in Table 1.
This table presents the results of assessing the compliance of educational programs with ten quality criteria. Each program (marked as ESP1.txt, ESP2.txt, etc.) is assessed against each of the criteria (1-11) presented in the Table 1 positions.

The quality criteria designations (Var1, Var2, ..., Var10) indicate different aspects of the assessment, such as design, structure and content of the program, access, quality of learning and teaching, control measures, human resources, learning environment, internal quality assurance, transparency and publicity, and prospects for further development.

Table 1 Assessment of compliance of educational programs with quality criteria.

<table>
<thead>
<tr>
<th>Designation of the的质量 criteria</th>
<th>Projecting and objectives of the educational program</th>
<th>Educational program's structure and content</th>
<th>Teaching under the educational program</th>
<th>Control measures, academic integrity</th>
<th>Human resources</th>
<th>Educational environment and material resources</th>
<th>Internal quality assurance of the educational program</th>
<th>Transparency and publicity</th>
<th>Prospects for further development of the EP</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESP1.txt</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0,6</td>
</tr>
<tr>
<td>ESP2.txt</td>
<td>0,8</td>
<td>0,8</td>
<td>0,6</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
</tr>
<tr>
<td>ESP3.txt</td>
<td>0,6</td>
<td>0,6</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,6</td>
<td>0,6</td>
<td>0,6</td>
<td>0,8</td>
</tr>
<tr>
<td>ESP4.txt</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>1</td>
<td>1</td>
<td>0,6</td>
<td>0,8</td>
</tr>
<tr>
<td>ESP5.txt</td>
<td>0,8</td>
<td>1</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>1</td>
<td>1</td>
<td>0,6</td>
<td>0,8</td>
</tr>
<tr>
<td>ESP6.txt</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>1</td>
<td>0,6</td>
<td>0,8</td>
</tr>
<tr>
<td>ESP7.txt</td>
<td>1</td>
<td>0</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>ESP8.txt</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,8</td>
<td>0,6</td>
<td>0,8</td>
</tr>
</tbody>
</table>

Source: Grechanyk and Plakhtyeyeva (2023)

The indicators in the table are given as numbers from 0 to 1, where 0 indicates low compliance and 1 indicates high compliance. For instance, for ESP1.txt, the indicator value of 0,8 for most of the criteria indicates a high quality of the program, but for the indicator Var9, the score is 0,6, which may indicate certain shortcomings in transparency and publicity of the program. The statistical evaluation of educational programs’ adherence to quality standards is presented in Table 2.

Table 2 presents the main descriptive statistical indicators for ten different quality criteria (Var1 to Var10). For each criterion, the following indicators are given:

- **Mean**: The arithmetic mean of the values obtained for a given criterion. For example, for Var1, the mean is 0.8.
- **Number of valid values (Valid N)**: The number of programs for which values were obtained for this criterion. In this case, 8 programs.
- **Median**: The value that divides the ordered assessments in half.
- **Mode**: The value that is most common in the distribution.
- **Frequency**: The number of times a criterion value is detected most often.
- **Minimum and maximum values (Minimum, Maximum)**: The smallest and largest values, respectively.
- **Quartiles (25,000th, 75,000th)**: Values that separate the bottom and top quarters of the distribution.
- **Geometric and harmonic averages (Geometric, Harmonic)**: Specific types of average values calculated using the geometric and harmonic formula, respectively.
- **Standard deviation and variance (Std.Dev., Variance)**: A measure of the diversity or dispersion of assessments.
- **Arithmetic average and range (Average, Range)**: The arithmetic average and the difference between the maximum and minimum values.
- **Skewness and kurtosis coefficients (Skewness, Kurtosis)**: They characterize the skewness and curvature of the distribution.
- **Sum**: The total amount of assessments for this criterion.
- **These data make it possible to get an idea of the distribution of assessments by different criteria and their features in the framework of the present research.**

This graph (Figure 1) shows that the results are divided into four clusters. In the context of cluster analysis, Euclidean distances measure the difference between clusters based on their position in space. The basic idea is that a lower distance indicates greater similarity between clusters. In particular, the strengths of the working programs are in positions: Cluster1: Var7. Educational environment and material resources Var8. Internal quality assurance of the educational program.
Table 2 Statistical assessment of compliance of educational programs with quality criteria.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Valid N</th>
<th>Median</th>
<th>Mode</th>
<th>Frequency</th>
<th>Minimum</th>
<th>Maximum</th>
<th>25,000th</th>
<th>75,000th</th>
<th>Geometric</th>
<th>Harmonic</th>
<th>Std.Dev.</th>
<th>Variance</th>
<th>Average</th>
<th>Range</th>
<th>Quartile</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Var1</td>
<td>0.800000</td>
<td>8</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>8</td>
</tr>
<tr>
<td>Var2</td>
<td>0.750000</td>
<td>8</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>8</td>
</tr>
<tr>
<td>Var3</td>
<td>0.800000</td>
<td>8</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>8</td>
</tr>
<tr>
<td>Var4</td>
<td>0.750000</td>
<td>8</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>8</td>
</tr>
<tr>
<td>Var5</td>
<td>0.800000</td>
<td>8</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>8</td>
</tr>
<tr>
<td>Var6</td>
<td>0.750000</td>
<td>8</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>8</td>
</tr>
<tr>
<td>Var7</td>
<td>0.800000</td>
<td>8</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>8</td>
</tr>
<tr>
<td>Var8</td>
<td>0.750000</td>
<td>8</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>0.750000</td>
<td>8</td>
</tr>
<tr>
<td>Var9</td>
<td>0.800000</td>
<td>8</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>8</td>
</tr>
<tr>
<td>Var10</td>
<td>0.800000</td>
<td>8</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>0.800000</td>
<td>8</td>
</tr>
</tbody>
</table>

Figure 1 Results of clustering data for assessing the quality of educational programs.

Cluster No. 1 has distances of 0.036111, 0.017778, and 0.008403 from clusters 2, 3, and 4, respectively. Cluster No. 2 has distances of 0.190029, 0.095000, and 0.043125 from clusters No. 1, 3, and 4, respectively. Cluster 3 has distances of 0.133333, 0.308221, and 0.03625 from clusters 1, 2, and 4, respectively. Cluster 4 has distances of 0.091667, 0.207666, and 0.175000 from clusters 1, 2, and 3, respectively.
The Table 3 presents the results of the analysis of variation (ANOVA) for different educational programs (designated as C_1, C_2, ..., C_8) by 10 evaluation criteria. The table contains the values of inter-group variation (Between), degrees of freedom for inter-group variation (df), within-group variation (Within), degrees of freedom for within-group variation (df), F-statistics (F), and the level of significance (signif.) for each criterion.

Each line of the table corresponds to one educational program (C_1 to C_8), and the results of the analysis are presented for each program. The F-statistic value and significance level indicate the statistical significance of inter-group variation compared to intra-group variation. It also provides an interpretation of each criterion that was assessed for each educational program. The criteria include the design and objectives of the educational program, structure and content, access to the program, learning and teaching, control measures, human resources, educational environment, internal quality assurance, transparency and publicity, and prospects for further development.

Table 3 Results of the analysis of variation (ANOVA) for different educational programs.

<table>
<thead>
<tr>
<th></th>
<th>Between</th>
<th>df</th>
<th>Within</th>
<th>df</th>
<th>F</th>
<th>signif.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_1</td>
<td>0,036000</td>
<td>1</td>
<td>0,08000</td>
<td>8</td>
<td>3,60000</td>
<td>0,094350</td>
</tr>
<tr>
<td>C_2</td>
<td>0,016000</td>
<td>1</td>
<td>0,12800</td>
<td>8</td>
<td>1,00000</td>
<td>0,346594</td>
</tr>
<tr>
<td>C_3</td>
<td>0,036000</td>
<td>1</td>
<td>0,04800</td>
<td>8</td>
<td>6,00000</td>
<td>0,039969</td>
</tr>
<tr>
<td>C_4</td>
<td>0,036000</td>
<td>1</td>
<td>0,08000</td>
<td>8</td>
<td>3,60000</td>
<td>0,094350</td>
</tr>
<tr>
<td>C_5</td>
<td>0,064000</td>
<td>1</td>
<td>0,08000</td>
<td>8</td>
<td>6,40000</td>
<td>0,035265</td>
</tr>
<tr>
<td>C_6</td>
<td>0,036000</td>
<td>1</td>
<td>0,08000</td>
<td>8</td>
<td>3,60000</td>
<td>0,094350</td>
</tr>
<tr>
<td>C_7</td>
<td>0,064000</td>
<td>1</td>
<td>0,03200</td>
<td>8</td>
<td>16,0000</td>
<td>0,003950</td>
</tr>
<tr>
<td>C_8</td>
<td>0,004000</td>
<td>1</td>
<td>0,03200</td>
<td>8</td>
<td>1,00000</td>
<td>0,346594</td>
</tr>
</tbody>
</table>

5. Discussion

The research results highlight important aspects of assessing the quality of education and the impact of standardization on this process. Let’s discuss the key problems of educational programs and their possible consequences for improving the quality of education. One of the main theses is that there are different methods of assessing the quality of education, and it is important to take into account their diversity when developing and improving educational programs (Dubaseniuk et al., 2020; Chen et al., 2021). Consideration of both quantitative and qualitative aspects, such as academic freedom, social responsibility, and innovation, can help create more comprehensive and balanced programs. The research also points to the key role of standardization in the process of assessing the quality of education. Standards can serve as an important measure of effectiveness, creating a common evaluation criterion for different programs. Nevertheless, in order for programs to be able to meet the particular requirements and qualities of various student groups, it is crucial to achieve a balance between uniformity and flexibility (Fettach et al., 2024). The mechanisms for improving the effectiveness of training programs are an additional topic for discussion. Our research indicates that state governance mechanisms should be dynamic and able to adapt to changes in society and technology (Sydorchuk et al., 2014; Elbrekht et al., 2022). The application of such principles as innovation and relevance can contribute to the creation of educational programs that meet modern challenges. Foreign and domestic experience shows that making a decision to modernize educational programs poses a significant challenge but also opens up opportunities for the parties to the educational process. This is important not only for young people who are just entering the professional market, but also for those who are already in the labor market and intend to improve their skills. The introduction of forms of distance learning for certain categories of students has posed a challenge; however, it can contribute to the universality of education for those who are temporarily or permanently unable to acquire knowledge via traditional forms of education. It is important to improve the process of modernizing the forms of education and expand international cooperation through international academic mobility, in particular Erasmus + KA1 (Shahjahan et al., 2022; Semenets-Orlova et al., 2023). However, our research is not conclusive. Further studies are needed to expand our understanding of the mechanisms of effective management and assessment of the quality of education. In particular, studying the impact of new technologies, teaching methods, and changes in society can provide additional information to improve the current system of higher education. An in-depth study of organizational mechanisms and principles of management of the system of higher education within the framework of public and state governance is proposed (Shcherbak et al., 2023).

Given the current challenges, the authors (Zagorodnya et al., 2020) suggest the need to develop new mechanisms that meet the requirements of the present time. In general, our research contributes to the understanding of the factors influencing the assessment of the quality of education and indicates opportunities for improving educational programs through effective management and consideration of current requirements and trends.

6. Conclusions
The research presented in the academic paper focuses on the methods of assessing the quality of education and the role of standardization in this process. The results of the analysis of international experience, comparative analysis, induction and deduction indicate the need for a thorough study of the issue of assessing the quality of education in the context of modern challenges. Special attention is paid to identifying key mechanisms aimed at improving the effectiveness of educational programs. The academic paper emphasizes the importance of standardization as a tool for improving educational programs and reveals innovative approaches and strategies for optimizing the learning process. The vector model presented for analyzing the texts of educational programs provides practical value to the research. The research results confirm the high assessment of the quality of educational programs, as indicated by numerical values, in particular, the average score of 0.8 on a relative scale. At the same time, it has been established that standardization, in particular, the use of a vector model for text analysis, is an important mechanism for improving the efficiency and quality of educational programs. The results, confirmed by static and variation analysis, provide a basis for implementing changes and improvements in the system of education. This research will be beneficial for guarantors of educational programs, educators and experts seeking to improve the effectiveness of educational programs and ensure a high standard of education.

Ethical considerations
Not applicable.

Conflict of Interest
The authors declare no conflicts of interest.

Funding
This research did not receive any financial support.

References


Docent, L. N. (2020). Methods and algorithms of analyzing syllabuses for educational programs forming intellectual system. Journal of theoretical and applied information technology, 98(05), 876-888.


