METHODS OF SUPPORTING ACCEPTANCE OF ECONOMICLY BASED DECISIONS IN THE MANAGEMENT OF THE QUALITY SYSTEM OF HIGHER EDUCATION

МЕТОДИ ПІДТРИМКИ ПРИЙНЯТТЯ ЕКОНОМІЧНО ОБГРУНТОВАНИХ РІШЕНЬ В УПРАВЛІННІ СИСТЕМОЮ ЯКОСТІ ВИЩОЇ ОСВІТИ

The aim is to influence the level of preparedness in both IT specialties and economic fields closely tied to IT technologies within higher or secondary educational institutions to meet the needs and requirements of diverse companies. Collaborative efforts between businesses and education can effectively tackle the challenge of cultivating high-quality potential personnel and enhancing students' readiness by establishing a standardized set of business demands.When outlining the requirements for IT specialties, crucial vectors encompass not only work experience and skills but also business qualities and the ability to collaborate in a work collective, aligning with company values. To precisely define the competencies of future employees, we advocate for the Delphi method as one of the best approaches. This method involves expert judgment and comprises multiple rounds of anonymous surveys within an expert group to reach a consensus.By fostering interactions between companies and educational institutions in the study, surveys can collect statistics and utilize educational plans that align with organizational interests. Proposed competencies by experts may convey similar semantic meanings but be articulated with different terminology. Additionally, merging similar competencies into more comprehensive ones is feasible. In the era of rapid IT development, addressing this issue can be accomplished through existing text analysis and comparison techniques in databases. Consequently, the unification of competencies can be established during the learning process [3].

Key words: *specialties, education institution (HEI), competencies, Delphi method.*

Мета наукової роботи полягає у впливі на рівень підготовки у вищих та середніх освітніх закладах майбутніх фахівців як в галузі ІТ, так і в економічних сферах, тісно пов'язаних з технологіями ІТ, для вимог та потреб кадрів різноманітних компаній. Спільні зусилля між бізнесом та освітою можуть ефективно вирішити завдання виховання висококваліфікованого персоналу та підвищення готовності студентів, створюючи стандартизований набір вимог бізнесу. Покращення якості інтелектуального потенціалу є одним із фундаментальних елементів, які формують конкурентоспроможність майбутніх фахівців та освітніх установ, що їх формують. Тому важливо визначити ключові питання та вимоги, які виникають при формуванні фахівців, які можуть конкурувати на ринку праці та покращити якість здобувачів освіти. При визначенні вимог до сучасних спеціальностей ключові вектори включають не лише робочий досвід і навички, але й бізнес-якості та здатність до співпраці у колективі, відповідно до цінностей компанії. Серед них визначено критерії та здатності, якими повинні володіти випускники вищих навчальних закладів, які є особливо важливими для роботодавців. Це стосується особливо фахівців, які повинні мати експертизу не лише в математиці, економіці чи інших галузях, але, що найважливіше, в інформаційних системах та технологіях, без яких сучасних фахівців уявити не можна. Це охоплює як загальні компетенції, так і ті, що спрямовані на відповідь сучасним вимогам роботодавців. Крім того, важливо розуміти, що якість освіти повинна бути на високому рівні і відповідати появі нових технологій та систем. Для точного визначення компетенцій майбутніх працівників пропонується метод Дельфі як один з найкращих підходів. Цей метод включає експертне судження і включає кілька раундів анонімних опитувань у групі експертів для досягнення консенсусу. Сприяючи взаємодії між компаніями та освітніми закладами під час дослідження, опитування можуть збирати статистику та використовувати навчальні плани, які відповідають організаційним інтересам. Запропоновані компетенції експертів можуть мати схожий семантичний зміст, але виражатися різними термінами. Крім того, об'єднання подібних компетенцій можливе в більш комплексні. Підтримка процесу управління прийняттям рішень в освітньому процесі покращить якість майбутніх фахівців. Результати об'єднань компетенцій можуть бути встановлені під час процесу навчання.

Ключові слова: *спеціальності, вищий освітній заклад (ВНЗ), компетенції, метод Дельфі.*

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Introduction. To impact the readiness of students in both IT specialties and fields closely associated with IT technologies in higher or secondary educational institutions, aligning with the needs and requirements of diverse companies is essential. Collaborative initiatives between businesses and educational institutions can effectively address the challenge of cultivating high-quality personnel and enhance students' preparedness by establishing a standardized set of business demands. Key indicators to consider include professional knowledge, practical skills, teamwork, business acumen, and alignment with corporate values.

Scholarly works by both domestic and foreign researchers, such as Bertchel O. [1], Pryimak V.I. [2], and others, delve into personnel management issues. Nevertheless, contemporary scientific literature lacks sufficient exploration of the question of effective personnel selection.

Presently, companies are open to taking on interns, providing training, and grooming specialists for their operations. However, forging partnerships between

employers and educational institutions during the learning stage may address the significant challenge of ensuring that potential professionals possess both the necessary theoretical knowledge and practical skills required by the company [3].

The main research findings. The consideration of modern employers' criteria and requirements becomes paramount when structuring the academic programs of higher education institutions. To formulate a comprehensive model for this academic field, every component must be taken into account. While emphasizing the importance of meeting employers' demands, equal attention must be given to the integration of online education.

The enhancement of intellectual output quality stands as a pivotal factor influencing the competitiveness of both future professionals and the institutions shaping them. To elevate the quality of intellectual output, it is imperative to support decision-making within educational management.

In simpler terms, graduates from higher education institutions should possess criteria and skills aligned with employers' requirements, as illustrated in Figure 1.

Therefore, it is crucial to identify key issues and challenges associated with preparing professionals for the job market and improving intellectual output. Previous research [4] delved into this matter, pinpointing primary elements related to management challenges and achieving high-quality intellectual output. These elements encompass the criteria and skills that graduates should possess, particularly those highly valued by employers.

This holds special relevance for professionals requiring expertise not just in mathematics, economics, or other fields, but most critically, in information systems and technologies – essential components of modern professional roles. These skills encompass both universal competencies and those tailored to meet the demands of contemporary employers. Additionally, it is crucial to acknowledge that the quality of IT education must remain high and adapt swiftly to the rapid emergence of new technologies and systems.

Subject and Methods. In delineating the prerequisites for IT roles, essential dimensions encompass not just professional experience and technical proficiencies but also essential interpersonal attributes and a knack for harmonizing with organizational values within a team dynamic. In our view, one of the most effective approaches for refining the skill set of prospective employees is the utilization of the Delphi method, which relies on expert evaluation.

This technique constitutes a collaborative form of expert appraisal, incorporating multiple rounds of anonymous surveys among the expert panel to establish a consensus. The foundation of this expert evaluation methodology is detailed in the materials outlined in [5].

If we consider the practical experience of IT companies, in the modern world, they strive to minimize unnecessary stages in refining the skills of higher education learners. Companies aim to engage with educational institutions, becoming stakeholders, to contribute to the enhancement of skills acquired by higher education learners, competencies, and learning outcomes that can be applied in real-life scenarios, particularly in team environments.

Hence, organizations are willing to gather data and any statistical information to further draw expert conclusions regarding consensus achievement with higher education institutions. Input information providing an opportunity to form a comprehensive portrait of a graduate can lead to positive changes in shaping a contemporary professional during discussions on curriculum planning between stakeholders and universities.

Moreover, it is essential to emphasize the need to undertake these efforts continually, as changes occur frequently and must incorporate the conditions of technological advancements, information systems, and the job market.

Characteristics of the expert assessment method as a scientific tool for solving intricate non-formalized problems include, firstly, a scientifically grounded structuring of all expertise stages, ensuring optimal efficiency at each step. Secondly, it involves the application of quantitative methods, both in the selection of experts and in the assessment of their judgments and the analysis of obtained results.

The manner of interacting with experts is contingent upon the chosen method for collecting expert information. Presently, various types of expert assessment methods are employed, categorizable into two groups: individual and group (collective) expert surveys. Methods falling into the first group entail individual collaboration between researchers and each involved expert. Conversely, group methods necessitate collective engagement of experts, either in person or remotely, demanding consensus among all experts and the formulation of a collective expert conclusion based on agreement.

The holistic application of intuition, logical reasoning, and quantitative assessments, coupled with formal processing, enables an effective problem-solving approach.

The method involves conducting remote and anonymous surveys among an expert group through multiple rounds to achieve a consensus. Experts receive survey sheets (questionnaires) pertaining to the research problem. These questionnaires may feature diverse formats, encompassing closed-ended and open-ended questions, considering both quantitative and qualitative responses. Variations

in the argumentation and justification of expert assessments may also be permitted or optional.

The methodology for carrying out expert assessments is grounded in the materials presented in [5].

The Delphi Method involves conducting several rounds of surveys. In each round, experts express their opinions and provide assessments of studied phenomena. Additionally, quantitative ratings of the main advantages of each set type are determined through "weighting," assigning a specific numerical value to each of them in a scoring system in the following sequence:

The initial step in conducting the expertise involves forming an expert group. Common practice recommends forming a group of 10-15 experts in the respective field (not exceeding 20 individuals). The list of experts is compiled based on their professional status, years of experience in managerial positions, and education.

The first stage involves a quantitative assessment of the qualitative significance of each advantage. This assessment is conducted using a scoring system. After completing the first round of surveys, for each advantage, experts calculate the overall significance coefficient using the provided formula [6]:

$$Q_j = \frac{\sum_{i=1}^{N} Q'_{ij}}{n}, \qquad (1)$$

where Q'_{ij} – is the quantitative rating of the importance of the j-th indicator given by the *i*-th expert after the first round of surveys,

n – is the number of experts.

a) When processing information obtained from experts, all ratings are arranged in descending order, and then the median (*M*), quartiles (*Q1, Q2*) are determined, dividing the scale into 4 parts.

b) Each expert is informed about the values of Q'_{ij} and Q_j based on the results of the first round of surveys, providing necessary motivation. If the ratings of some experts fall into extreme intervals, they are anonymously asked to justify their opinion on providing such ratings. The justifications from these experts are considered by other participants. Experts can refine their ratings, and in the second round, they fill out a questionnaire with new assessments.

In the second round, experts determine the final coefficients of “weight” for any *j*-th indicator Q'_{ij} with corresponding justifications and clarifications. The final coefficients of “weight” for any *j*-th indicator Q''_j are established using a formula similar to the one used in the first round:

$$Q''_j = \frac{\sum_{i=1}^{N} Q''_{ij}}{n} \qquad (2)$$

The feasibility of conducting a third round of expert surveys is enabled, typically strengthening the convergence of expert opinions in rating assessments with each new round. This leads to more consistent scores for each indicator, refining the "weights" of product advantages more accurately. After several rounds, discrepancies in assessments become insignificant, and divergent viewpoints are documented for decision-making. This method proves relevant for determining the probability of risky events, assessing losses, and the probability of losses falling within a certain interval.

The iterative nature of multiple rounds allows for the refinement of opinions and a convergence toward consensus, making the Delphi Method valuable in situations where experts' judgments play a crucial role in decision-making. By incorporating the interaction between IT companies and educational institutions into the research, surveys can be conducted, statistics gathered, and educational plans utilized, all approved by organizations interested in collaboration.

Experts are provided with a questionnaire containing a basic list of characteristics influencing a professional's competitiveness. To address issues in educational process management and enhance the quality of intellectual output, it is crucial to embrace not only existing methods, technologies, and opportunities but also new approaches, including various forms of online learning such as distance learning platforms.

Critical criteria and methodologies aimed at improving graduates' skills and attracting employers' attention to students using modern approaches are currently essential. Global experience emphasizes a graduate's professionalism as paramount for employers. Hence, utilizing existing and emerging opportunities is necessary for preparing professionals.

Even during university education, students should acquire new knowledge and skills to become qualified professionals in high demand in the job market. These efforts to enhance students' education level will make them competitive in the future, achievable through continuous improvement of the educational process, adoption of new technologies, and professional development of instructors implementing these technologies.

In addressing complex non-formalized problems where statistical approaches are inapplicable, experts play a significant role. Therefore, the Delphi method is considered relevant for resolving these issues. The essence lies in experts conducting intuitive-logical analysis with quantitative assessment and formal processing of results. The synthesized expert opinion resulting from this processing is accepted as the solution to the problem.

Building such a scheme is a complex task, requiring collaboration with experts. The author should distribute the developed questionnaire to the experts, containing a basic list of characteristics influencing IT professionals' competitiveness.

One drawback of expert methods is the labor-intensive processing, especially with textual information. The proposed competencies may carry the same semantic load but be described differently. In the era of rapid information technology development, addressing this is possible using existing advancements in comparing and analyzing textual information in databases [4; 5].

Using a specific set of criteria (employer requirements and university competencies), set intersection and union operations can be applied to Employers and Higher Education Institutions (HEIs). This allows the construction of a linear function, serving as an objective function for maximizing performance quality and qualifications. Weight coefficients indicate the importance of each factor from an expert perspective, enabling the adjustment of model parameters for enhanced knowledge attainment. These factors contribute to the acquisition of quality education, shaping a competitive professional.

Solving a scientific problem. In other words, by initially employing analysis, modeling, manipulation of the subject area, utilizing expert assessment, and then employing mathematical tools to solve the problem, it is possible to streamline and enhance the process of preparing professionals with contemporary knowledge and skills, which are rapidly evolving in our time. This can be achieved through the creation and analysis of a subject area model, information management within this domain, and the application of specific methods described in the article, not only improving educational services but also meeting the needs of stakeholders. This is particularly achieved by aligning with the modern employer's requirements.

Before delving into the development of any model or system, it is essential to first design and select a data model that allows for the definition of data, their relationships, and constraints imposed on the data within the research context. For this purpose, the following categories of data models can be used: object-oriented, record-based, and physical. The first two are used to describe data at the conceptual (subject area) and external (logical data representation) levels, while the last one is employed at the internal level.

At the conceptual level, an "Entity-Relationship" (ER) model should be utilized. It will help define all objects belonging to the research subject area and the relationships established among them, forming the basis for the research. This model will serve as a graphical representation of the metamodel.

Logical data representation should be organized using a relational data model, which is currently one of the most widespread approaches. It provides a convenient data structure and allows the use of relational algebra for analysis. All these qualities are necessary both for conducting research and for implementing software in line with the research findings.

Since the methods for building a system that will facilitate research have already been defined, it is necessary to explain how this system will be utilized during the research process. Additionally, it is important to specify the scope of application of the research results within this system.

The entire path from searching for methods to implementing the stated problem, as described above, will allow for improving the interaction system between educational institutions and companies.

Results and Conclusions. The competencies suggested by experts may share similar semantic meanings but may be articulated with varying terminology. Furthermore, the consolidation of akin competencies into more comprehensive ones is achievable. In the era of swift IT development, addressing this matter can be facilitated through the utilization of existing text analysis and comparison techniques in databases.

Through the application of expert assessment methods, it is also feasible to ascertain the alignment of educational qualification levels at different accreditation stages. Consequently, the unification of competencies can be instated as an integral part of the learning process.

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