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EDUCATIONAL INFRASTRUCTURE GRADING INDEX AS AN EVALUATION TOOL OF HIGHER-EDUCATIONAL INSTITUTIONS IN THE REPUBLIC OF MOLDOVA

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Abstract. This paper proposes an index of grading for evaluation of educational infrastructure. It is based on the results from a survey regarding the assessment of the accessibility of the population of the Republic of Moldova to the educational infrastructure of higher-educational institutions from the viewpoint of the students. The aspects covered by the survey include: assesment of quality of the sanitary and hygienic conditions in the educational institution, the technical and material base of the institution, the professional-pedagogical qualities of the staff, the quality of food products in the institution (if it offers them, e.g. in the canteen), the living conditions in the dormitory (in the case of accommodation in the institution's dormitory).

Keywords: higher-educational institutions, evaluation, student, educational infrastructure grading index, Moldova.

The state of education is a crucial factor in society development. Adequate educational infrastructure is pivotal in maintaining the state of education field at high level. Even though in scientific literature there are many studies evaluating some aspects of education infrastructure [1-4] an integral approach to evaluation of educational infrastructure is missing. We substantiated the theoretical considerations for such a tool and elaborated the methodology for it. To calculate it we used the data of a survey which we elaborated and spread between students from higher-educational institutions. The aspects covered by the survey included: assesment of quality of the sanitary and hygienic conditions in the educational institution, the technical and material base of the institution, the professional-pedagogical qualities of the staff, the quality of food products in the institution (if it offers them, e.g. in the canteen), the living conditions in the dormitory (in the case of accommodation in the institution's dormitory). We propose a composite index of grading for evaluation of educational infrastructure on the basis of survey data regarding the evaluation of the accessibility of the population of the Republic of Moldova to the educational infrastructure of higher-educational institutions from the viewpoint of the students.

Limits of the research. Data used for calculating the composite index of the second degree represents only a sample of all population of beneficiaries and is limited to Republic of Moldova beneficiary and institutions. Only five general aspects were taken into consideration in calculating the index from a multitude of other general aspects and of a more particular nature. The data don’t come from objective sources and are obtained from respondents’ answers of and may suffer from

subjectivity bias. Overall, composite indices, also termed composite indicators or aggregates, represent consolidated measures that amalgamate various indicators or variables into a singular index.

Composite indices themselves have those shortcomings:

1) Subjectivity in Weighting: Determining the weights assigned to each component in a composite index can be subjective and may vary based on the preferences or biases of the index creation. The choice of weights can significantly influence the final index value and may not accurately reflect the importance of each indicator to the overall assessment.

2) Data Limitations: Composite indices depend on the availability and reliability of data for their constituent indicators. Inconsistencies, inaccuracies, or gaps in data can compromise the accuracy and comparability of the index. Some components may be easier to quantify than others, leading to a potential bias in favor of indicators that are more readily measurable.

3) Dynamic Nature of Indicators: Over time, the relevance and significance of certain indicators may change. Composite indices may struggle to adapt quickly to evolving social, economic, or environmental trends. The fixed nature of composite indices may not capture sudden changes or emerging issues that become important after the index is created.

4) Normalization Issues: The process of normalizing indicators to a common scale can introduce challenges. Different normalization methods may yield different results, impacting the comparability of indices across regions or time periods. Normalization may not always capture the non-linear relationships between indicators, potentially distorting the final assessment.

5) Aggregation Challenges: Aggregating diverse indicators into a single value involves assumptions about the relationships between them. These assumptions may oversimplify complex interactions and overlook synergies or trade-offs between indicators. Aggregation methods may not account for interactions where improvements in one area compensate for deficiencies in another.

6) Inherent Value Judgments: Composite indices reflect the values and priorities of the index creators, incorporating their judgments about what constitutes progress or success. This subjectivity may not align with the perspectives of all stakeholders.

7) Lack of Transparency: Some composite indices may lack transparency in terms of their methodologies, making it challenging for users to understand how the index values are calculated. This can undermine the credibility and usefulness of the index.

8) Regional and Cultural Variations: Indices developed in one cultural or regional context may not be universally applicable. Differences in social, economic, or environmental priorities may not be adequately captured in a one-size-fits-all composite index.

Despite these shortcomings, composite indices remain valuable tools for summarizing complex information and providing a quick overview of multi-dimensional phenomena. Users should interpret them with caution, considering the context, methodology, and limitations associated with each index.

These indices find widespread application across diverse fields, presenting numerous benefits:

1) Simplicity and Communication: Composite indices simplify intricate information by condensing multiple indicators into a solitary value which aids policymakers, researchers, and the general public in comprehending and conveying trends and performance more easily.

2) Holistic Perspective: Through the amalgamation of multiple indicators, composite indices furnish a more thorough and holistic understanding of a phenomenon, system, or entity. This comprehensive view captures the multifaceted nature of intricate concepts like development, sustainability, or quality of life.

3) Comparisons and Ranking: Composite indices facilitate the comparison and ranking of various entities (countries, regions, organizations) based on specific criteria. This proves valuable for decision-makers in discerning strengths, weaknesses, and areas necessitating improvement.

4) Policy and Decision-Making: As decision-making tools, policymakers can utilize composite indices to guide resource allocation, policy formulation, and strategic planning by pinpointing areas requiring attention or intervention.

5) Risk Assessment: In diverse fields, composite indices find utility in assessing risks by combining indicators associated with different aspects of a system. This proves particularly beneficial in areas such as finance, environmental monitoring, and public health.

6) Efficiency in Data Handling: Rather than scrutinizing a plethora of individual indicators, composite indices streamline the data analysis process. This efficiency is especially crucial when grappling with extensive datasets, potentially saving time and resources.

7) Long-Term Trends: Composite indices furnish insights into long-term trends and alterations by monitoring the performance of multiple indicators over time. This aids in comprehending the dynamics of a system and evaluating the impact of policies or interventions.

8) Weighting Flexibility: Composite indices permit the assignment of varying weights to individual indicators based on their relative importance. This flexibility allows for customization according to specific goals or contexts.

9) Addressing Data Gaps: In instances where data for certain indicators is incomplete or unavailable, composite indices can still offer a meaningful summary. They help bridge data gaps by relying on available information to construct a more comprehensive picture.

10) Public Awareness and Advocacy: Composite indices are frequently employed in advocacy endeavors to enhance public awareness about specific issues. They serve as potent tools for conveying the significance of particular goals or drawing attention to areas in need of improvement.

While composite indices provide these advantages, it's crucial to acknowledge their limitations, including potential oversimplification, subjectivity in weighting, and sensitivity to changes in data sources. Diligent consideration and transparency in methodology are imperative when developing and interpreting composite indices.

Theoretico-methodological considerations: general aspects. Compositeness degree (C) of a composite index represents the number of nested iterations of successive arithmetic operations between indicators from the primary indicators to composite index itself. Its value is equal to degree of the subindex of highest degree (*n*), thus a composite index is composed of *n* types of subindices of degrees from *1* to *n*. A nested iteration of succesive arithmetic operations between indicators is an iteration that includes in itself the previous one adding subindices of its corresponding degree.

By convention, a composite index of zero degree (*C=0*) is the primary indicator which is not composite by definition, that is why composite indices will be considered from *C=1* and higher. A composite index of the first degree represents *1* iteration of arithmetic operations between indicators. It has one type of subindices – the primary indicators, and its compositeness degree is *1 (C=1)*. A composite index of the second degree represents *2* successive iterations of arithmetic operations between indicators. It has *2* types of subindices – the primary indicators with *C=1* and the subindices of second degree (*C=2*) (which they are composed themselves from the iteration of subindices of first degree). In general case, a composite index of the *n-th* degree represents *n* nested iterations of arithmetic operations between indicators. It has *n* types of subindices – the primary indicators with *C=1* and the subindices from second degree until the *n-th* degree (*C=n*) (which they are composed themselves from the iteration of subindices of degree *n-1*).

A subindex of *n-th* degree will be noted as $S^{\{n\}}$ (warning: to not be confused with the fractional part of a number also noted with curly brackets "{}"). The primary indicator will be written as $S^{\{1\}}$.

Since average weighted mean is the usually used type of nested iterations of successive arithmetic operations between indicators, we will focus the methodology on this type of iterations.

The formulas for subindex of first degree is indicated in (1) and for the one of second degree in (2), for general case in (3) (***Figure 1***).

$$S^{\{1\}}=\frac{1}{k_1}*\sum_{i=1}^{k_1} S_i^{\{1\}}*w_{S_i^{\{1\}}}, \quad (1)$$

$$S^{\{2\}}=\frac{1}{k_2}*\sum_{i=1}^{k_2} S_i^{\{2\}}*w_{S_i^{\{2\}}}, \quad (2)$$

$$\dots$$

$$S^{\{n\}}=\frac{1}{k_n}*\sum_{i=1}^{k_n} S_i^{\{n\}}*w_{S_i^{\{n\}}}, \quad (3),$$

where w - the respective weight of subindex component, k - the number of components of a subindex ($k_i=\overline{1,n}$, $1 \le i \le n$).

Figure 1. Formulas of the composite indices
Source: elaborated by the author

Theoretico-methodological considerations: particular aspects. For the purpose of this paper we used the formula (2), because we used 2 nested iterations. First iteration contains the average weighted mean of subindices of the first degree (i.e. the primary indicators), which in our case is the appreciation grade of an aspect of educational institution weighted by the coefficient of the share of the respondents that chose the corresponding appreciation grade. Second iteration represents the average weighted mean of the subindices of second degree, weighted equally with coefficient 1, which represent the composite indices of each researched aspect of the educational institution. Because the weight is 1 the average weighted mean becomes a simple arithmetic mean.

Our final index - the composite index of second degree includes five subindex components of second degree: quality of the hygienic and sanitary conditions within the educational institution; technical and material base of the institution; professional-pedagogical qualities of the staff; quality of the food products in the institution (if it offers them, e.g. in the canteen); living conditions in the dormitory (in the case of accommodation in the institution's dormitory).

Each subindex component is evaluated on the basis of a scale of 11 grades (the subindices of first degree): from Grade -5 the most negative appreciation to Grade +5 the most positive appreciation, in the middle of them is Grade 0 – neutral appreciation (***Table 1***). Each Grade weight coefficient is equal to its corresponding share size of respondent answers in percents divided by 100. Each subindex is calculated as weighted arithmetic mean.

The data of the composite index we elaborated are obtained from the survey in which 560 people aged 18-25 years old participated, of which 55.9% were women and 44.1% were men. Of all respondents, 30.7% used private educational services, 69.3% - public.

Table 1. Survey data on the aspects of educational infrastructure, percent of total respondents

What grade do you give to the educational infrastructure where you study (from -5 the lowest to 5 – the highest)?	How do you rate the quality of the hygienic and sanitary conditions within the educational institution?	How do you rate the technical and material base of the institution?	How do you rate the professional-pedagogical qualities of the staff?	How do you rate the quality of the food products in the institution (if it offers them, e.g. in the canteen)?	How do you rate the living conditions in the dormitory (in the case of accommodation in the institution's dormitory)?
Grade -5	5.0	5.7	6.4	8.3	8.7
Grade -4	16.4	15.7	16.4	16.7	17.3
Grade -3	9.3	6.4	5.0	6.7	12.5
Grade -2	4.3	2.9	0.7	3.3	4.8
Grade -1	6.4	0.7	0.0	1.7	1.9
Grade 0	7.1	9.3	4.3	14.2	22.1
Grade 1	3.6	5.7	2.9	4.2	3.8

Grade 2	9.3	7.1	2.9	6.7	3.8
Grade 3	16.4	21.4	15.0	13.3	9.6
Grade 4	12.1	12.1	22.1	11.7	4.8
Grade 5	10.0	12.9	24.3	13.3	10.6

Source: elaborated by the author on the basis of survey results

The ***Table 1*** shows that in regard to negative appreciation 1 student from 6 appreciated very negatively the quality of the hygienic and sanitary conditions within the educational institution, the technical and material base of the institution, the technical and material base of the institution, the professional-pedagogical qualities of the staff, the quality of the food products in the institution (if it offers them, e.g. in the canteen), the living conditions in the dormitory (in the case of accommodation in the institution's dormitory). 1 in 5 students appreciated neutrally the living conditions in the dormitory (in case of accommodation in the institution's dormitory), while 1 from 7 students appreciated neutrally the food products in the institution (if it offers them, e.g. in the canteen).

From positive appreciations, 1 in 6 students appreciated positively on average the quality of the hygienic and sanitary conditions in the educational institution, 1 in 5 - positively on average the technical and material base of the institution, circa 1 in 2 positively highly and very highly - the professional-pedagogical qualities of the staff, 1 in 7-8 students positively on average - the quality of food products in the institution (if it offers them, e.g. in the canteen), 1 in 10 students positively very highly - the living conditions in the dormitory (in case of accommodation in the institution's dormitory).

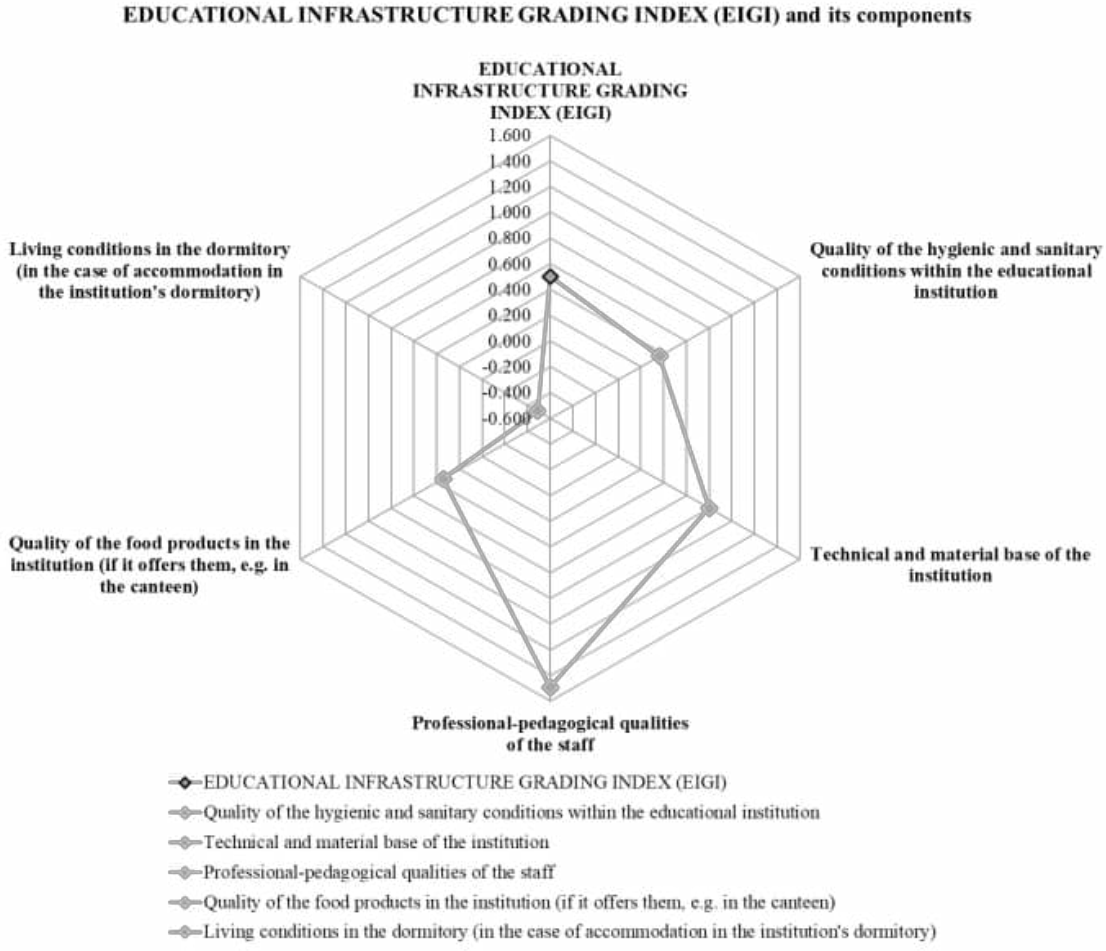

Figure 2. Educational Infrastructure Grading Index and it's components
Source: elaborated by the author on the basis of survey results

In the ***Figure 2*** is shown the Educational Infrastructure Grading Index and it's components. As we see in the figure most highly were evaluated the professional-pedagogical qualities of the staff (1.493), followed by: technical and material base of the institution (0.800), quality of the hygienic and sanitary conditions within the educational institution (0.364), quality of the food products in the institution (if it offers them, e.g. in the canteen) (0.342), while living conditions in the dormitory (in the case of accommodation in the institution's dormitory) were evaluated more negatively (-0.490). Overall, the Educational Infrastructure Grading Index (EIGI) is positive (0.502). The EIGI index has the maximum positive value +5 and the minimum negative value -5, thus $-5 \leq EIGI \leq +5$. Maximum positive value is attained in case if all respondents appreciate with +5 (maximally possible) the respective aspect of educational infrastructure and minimum negative value is obtained in case if all respondents appreciate with -5 (minimally possible) the respective aspect of educational infrastructure.

We consider the following scale of evaluation of EIGI index: [-5; -4) - maximally negatively satisfied; [-4; -3) - medium-to-high negatively satisfied; [-3; -2) - average negatively satisfied; [-2; -1) - low-to-medium negatively satisfied; [-1; 0) - minimally negatively satisfied; 0 – neutral; (0; +1] - minimally positively satisfied; (+1; +2] - low-to-medium positively satisfied; (+2; +3] - average positively satisfied; (+3; +4] - medium-to-high positively satisfied; (+4; +5] - maximally positively satisfied. Based in this scale professional-pedagogical qualities of the staff are evaluated as low-to-medium positively satisfied; minimally positively satisfied - technical and material base of the institution, quality of the hygienic and sanitary conditions within the educational institution, quality of the food products in the institution (if it offers them, e.g. in the canteen) and minimally negatively satisfied - conditions in the dormitory (in the case of accommodation in the institution's dormitory) which were evaluated more negatively.

Conclusions

In conclusion, this study introduces the Educational Infrastructure Grading Index (EIGI) as a comprehensive tool for evaluating the educational infrastructure of higher-educational institutions in the Republic of Moldova. The index, derived from data of a survey of students, encompasses crucial aspects such as sanitary conditions, technical and material resources, pedagogical qualities of staff, food quality, and dormitory living conditions of the higher-educational institutions.

The research highlights importance of educational infrastructure in societal development and acknowledges absence of an integrated approach in existing literature. The proposed EIGI aims to fill this gap, offering a multidimensional perspective on the accessibility of educational infrastructure.

However, certain limitations need consideration. The data used for the composite index represent a sample rather than the entire population of beneficiaries in the Republic of Moldova. The reliance on subjective responses introduces potential biases. Additionally, composite indices, while valuable, are not without shortcomings, such as subjectivity in weighting, data limitations, and challenges in normalization and aggregation.

Despite these limitations, composite indices like EIGI provide a simplified means of summarizing complex information. The study demonstrates that such indices can be instrumental in policy-making, resource allocation, and decision-making processes. They offer a holistic view, aiding in comparisons, ranking, risk assessment, and long-term trend analysis.

The EIGI results indicate generally positive evaluations, with professional-pedagogical qualities of the staff receiving the highest rating. The scale used for interpretation categorizes aspects as minimally to maximally negatively or positively satisfied. The findings suggest that while certain areas are positively assessed, improvements could be made in dormitory living conditions.

In conclusion, EIGI proves to be a valuable instrument for evaluating higher-educational institutions in the Republic of Moldova, providing insights that can inform policy decisions and institutional improvements. Further research and refinement of the index may enhance its applicability and contribute to the ongoing discourse on educational quality and infrastructure.

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