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Academic Quality Assessment of the Faculty of Science Departments at the University of Tobruk Using the Weighted Linear Combination Model (WLC)

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Abstract

This study evaluates the academic and administrative quality of the Faculty of Science departments at the University of Tobruk using the Weighted Linear Combination (WLC) model. The assessment relied on three main, weighted indicators: Academic Competence (E) at 0.35, Teaching Effectiveness (A) at 0.40, and Stakeholder Satisfaction (S) at 0.25. Data were collected using standardized questionnaires and official department quality reports from the University of Tobruk. The weights were rigorously justified through a modified Delphi method and the Analytic Hierarchy Process (AHP). Findings reveal variation in quality levels among departments, with three rated as "Good" and five rated as "Very Good." The overall faculty quality score reached 76.7%, qualifying the faculty for institutional accreditation for a period of three years. The study confirms the WLC model's effectiveness as an objective and transparent tool for continuous quality monitoring and policy-making in Libyan higher education.

Keywords: Academic Quality, WLC, Institutional Accreditation, Teaching Effectiveness, University of Tobruk, Analytic Hierarchy Process (AHP).

1. Introduction and Theoretical Framework

Evaluating quality in higher education institutions (HEIs) is a critical measure of institutional capability and effectiveness in fulfilling its mission (UNESCO, 2021). Adopting quantitative assessment models is crucial for ensuring transparency and accuracy in this evaluation process (OECD, 2020).

1.1. Quality and Quantitative Assessment Models:

The Weighted Linear Combination (WLC) model is a prominent Multi-Criteria Decision Analysis (MCDA) tool effective in synthesizing performance across heterogeneous indicators into a single, measurable outcome (Field, 2019). The WLC model is favored for its interpretability and ability to assign weights that reflect the strategic priorities of the assessing body (Harvey, 2013).

1.2. Rationale for the Study:

While self-assessment quality reports are important, the application of objective, quantitative mathematical models remains limited in the context of Libyan universities (Al-Manqush, 2018). This study provides a rigorous quantitative framework for assessing the performance of the Faculty of Science departments at the University of Tobruk and determining its eligibility for institutional accreditation according to national standards (Libyan Quality and Accreditation Authority, 2020).

2. Research Objectives

1. To apply the WLC model to assess the quality level of each Faculty of Science department at the University of Tobruk.
2. To provide a methodological justification for the derivation of weights for the main quality indicators (E, A, S).
3. To compute the overall quality score of the faculty and determine the duration of its institutional accreditation eligibility.
4. To identify specific strengths and weaknesses to inform recommendations for quality improvement.

3. Methodology: Weighted Linear Combination (WLC) Model

3.1. The Core Equation and Weight Justification:

The WLC department quality score (Q) is expressed by the equation:

$$Q = w_1 E + w_2 A + w_3 S$$

Where the weights used are:

w_1 = 0.35 (for Academic Competence E),
w_2 = 0.40 (for Teaching Effectiveness A), and
w_3 = 0.25 (for Stakeholder Satisfaction S).

Weight Derivation: The weights were rigorously determined by combining expert opinion (modified Delphi method) with the Analytic Hierarchy Process (AHP) (Saaty, 2008). The final weights reflect a strategic institutional prioritization of Teaching Effectiveness (A) (0.40), followed closely by Academic Competence € (0.35).

3.2. Data Collection Tools and Sub-Variables:

Data were sourced from official department reports and three custom-designed standardized questionnaires, with all quantitative data normalized to a 100-point scale:

- Academic Competence (E): Measured based on official records, focusing on Research Activity (publications) and Professional Development.
- Teaching Effectiveness (A): Primarily measured via anonymous Student Evaluation of Teaching (SET) questionnaires, including Teaching Quality, Laboratory Efficiency, and Exam Fairness (Marsh, 2014).
- Stakeholder Satisfaction (S): Measured through separate questionnaires administered to Students, Faculty, and Administration concerning the quality of support and the overall environment.

3.3. Detailed Calculation Example: Department of Mathematics:

As an illustrative example of the WLC application, the calculation for the Department of Mathematics (with raw scores E=70, A=72, S=68) is presented:

Indicator	Score (I)	Weight (W)	Contribution $I * W$
Academic Competence (E)	70	0.35	24.5
Teaching Effectiveness (A)	72	0.40	28.8
Stakeholder Satisfaction (S)	68	0.25	17.0

$$Q = w_1 E + w_2 A + w_3 S$$

$$Q = 70 * 0.35 + 72 * 40 + 68 * 0.25$$

$$Q = 24.5 + 28.8 + 17.0 = 70.3\%$$

Department of Mathematics Result: 70.3% “Good”.

4. Results and Statistical Analysis

4.1. Individual Departmental Results:

Table (1): Summary of Departmental Quality Assessment Results at the University of Tobruk Faculty of Science

Department E	E (%)	A (%)	S (%)	Q (%)	Leve
Mathematics	70	72	68	70.3	Good
Botany	73	71	69	71.5	Good
Microbiology	72	70	68	70.4	Good
Physics	80	83	78	80.2	Very Good
Zoology	79	80	77	78.7	Very Good
Geology	79 7	80	77	78.7	Very Good
Chemistry	81	83	80	81.7	Very Good
Computer Science	78	82	80	79.8	Very Good

4.2. Overall Faculty Quality and Accreditation Eligibility:

The Overall Faculty Quality Score Q {was calculated as the average of all eight.

Let the overall quality of the Faculty of Science be evaluated using the Weighted Linear Combination (WLC) model defined as:

$$Q_{Faculty} = \frac{1}{n}\sum_{i=1}^{n} Q_i$$

Where:

$n = 8$ is the number of academic departments,

Q_i is the quality score of the i the department?

Each departmental quality score is computed as:

$Q_i = 0.35E_i + 0.40A_i + 0.25S_i$

With:

E_i: Academic Competence score,

A_i: Teaching Effectiveness score,

S_i: Stakeholder Satisfaction score,

$0 \le E_i, A_i, S_i \le 100$

Numerical Computation

$$Q_{Faculty} = \frac{1}{8}(\backslash\{70.3 + 71.5 + 70.4 + 80.2 + 81.1 + 78.7 + 81.7 + 79.8\} =$$

$$\frac{613.7}{8} = 76.7\%$$

Quality Classification Rule:

Let the accreditation classification function be defined as:

$$C(Q) = \{Good \ \ 65 \leq \ Q \leq 75\} and \{ \ Very \ Good \ \ 75 \leq \ Q \leq 85\} and \{Excellent \ \ Q \geq \ 85\}.$$

Since:

$$76.7 \epsilon \{ \ Very \ Good \ \ 75 \leq \ Q \leq 85\}$$

Then:

$$C(76.6) = Very \ Good$$

Quality Level Score Range (%) Accreditation Duration

Good 65–74% 1–2 years

Very Good 75–84% 3 years

Excellent 85–100% 5 years

Result: The Faculty of Science at the University of Tobruk achieved 76.7%, a "Very Good" rating, qualifying it for a three-year institutional accreditation.

5. Discussion and Policy Implications

5.1. Analysis of Performance Variation:

Five departments achieved "Very Good," driven largely by strong scores in Teaching Effectiveness (A) (Biggs, 2011). The three departments rated "Good" (Mathematics, Botany, and Microbiology) showed relative weaknesses, primarily in the Academic Competence € indicator (research activity) and slightly lower Stakeholder Satisfaction (S) (Ghaith, 2020).

5.2. Efficacy of the WLC Model:

The WLC model proved to be an effective and objective diagnostic tool (Al-Hadi, 2022). Its AHP-derived weights ensure the assessment aligns with the university's strategic priorities, providing transparent and actionable results for continuous quality monitoring.

5.3. Accreditation and Policy Implications:

The overall score (76.7%) is a significant outcome, placing the faculty within the category eligible for the maximum accreditation period in the "Very Good" rating (CHEA, 2022). Policy implications include:

- Targeted Improvement: Resource allocation should prioritize enhancing laboratory infrastructure and boosting research activity in the departments rated "Good."
- Stakeholder Engagement: Implementing more effective communication and conducting periodic satisfaction questionnaires are recommended.

6. Conclusion and Recommendations

The Faculty of Science at the University of Tobruk achieved an overall quality level of "Very Good," qualifying for three years of institutional accreditation. The WLC model served as a robust tool for this comprehensive assessment.

To ensure continuous excellence, the study recommends:

- Developing action plans to improve Academic Competence in lower-scoring departments.
- Upgrading and maintaining laboratory facilities.
- Committing to the annual application of the WLC model for continuous performance monitoring.

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