Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 44 No. 5 (2023)

# Big Data Analytics and a Multidimensional Evaluation Method for Improving the Performance of HEIs

**[1] Waleed Khalid Al-Raghi and Zuhair A. Al-Hemyari,**

*[1] University of Nizwa, Nizwa, Oman*

***Abstract***
In order for the Higher Education Institutions in the world to work effectively they have collected data, and been developing Multi-dimensional Evaluation method and several indicators through many internal mechanisms for the purpose of improving the performance of institutions, achieving the goal of internal accountability over their activities, identifying effective teaching and learning practices, strengthening the research activities and outcomes, and developing the institutional environment; at the same time they are achieving the above requirements of accountability, quality and transparency.
In this paper extensive data is collected, and multidimensional evaluation methods will be proposed to assess the current status of the administrative, educational, and research systems of any Higher Education Institution; and a non-profit university will be taken as a case study (University of Nizwa, Oman) to apply and assess the classes of indicator.
The data for this research was collected through a random sample of 304 academic staff. The results of dimensional evaluation/ indicators of the academic staff will be given and analyzed in this paper. It may be mentioned here, the survey contains 22 dimensions and 156 indicators. In addition, the statistical analysis of this paper is accurate, comprehensive, and describes the evaluation of all the dimensions and indicators.
***Keywords:*** *Big Data Analytics, Multi-dimensional Evaluation, Institutional Performance, Reliability and Consistency.*

## 1. Introduction

The use of multidimensional evaluation methods and analytic techniques in Higher Education Institutions (HEIs) is for the purpose of obtaining a reliable assessment of institutional performance, improving the decision-making process for the executives, providing better services to stakeholders, improving resources, and in supporting the achievement of specific learning goals (Lesjak, et al., 2021; Nguyen,et al., 2020; Tasmin, et al., 2020; Chaurasia, et al., 2018; Long and Siemens, 2011; Campbell, et al., 2007).

The multidimensional evaluation method is well-known, and developed in international organization and HEIs (see, Metsäpelto, et al., 2022 and Herbert and Bailey, 1993) is defined as “a type of evaluation that articulates different dimensions or different constructs with theoretical coherence” (ibid). In addition, the learning analytic is defined as “the measurement, collection, analysis and reporting of data about learners and their contexts for purposes of

understanding and optimizing learning and the environments in which they occur" (Caspari- Sadeghi, 2023, p.3 and Long & Siemens, 2011, p. 34). Also, "academic analytics is broadly referred to as data-driven decision-making practices of analyzing institutional data" (Tasmin, et al., 2020; p.1). In addition, analytic techniques "involve the use of a broad range of data and techniques for analysis – covering, for example, statistical tests, explanatory and predictive models, and data visualization" (Wong, 2017; p.2).

It is well-known that the issue of big data and how to analyze it is getting more important day by day. In addition, the big data is available, and then the need to analyze it appears in a number of sectors, including the Higher Education sector. HEIs have greatly increased the awareness of the purpose of collecting evidence on their performance, i.e. data - which is big data, on the nature of their various activities, as HEIs operate under increasing pressure and in an intensely competitive environment (Caspari- Sadeghi, 2023; Khaw, and Teoh, 2023; Lesjak, et al., 2021; Daniel, 2014).

At a time when the issue of the existence of big data has become realistic, and at the same time the decision-making processes in HEIs that rely on big data, and the results of related research have become vital issues that cannot be ignored, it is widespread in many sectors of modern society, especially the Higher Education sector (ibid).

Extensive amounts of HEIs data are available through various surveys, online platforms, and other communication tools and applications, and without doubt, all of these sources provide new types of factual evidence for the performance and quality of HEIs (ibid). In addition, "big data enable investigations to be conducted and reliable conclusions to be drawn that would otherwise be difficult or impossible" (Cox, et al., 2018; p.114).

As it is known, HEIs always rely on various multidimensional evaluation strategies to obtain results with implications. However, the extensive amount of the available data, and the different methods of collecting it at different levels, as it comes from different sources and environments without unified scales of measurement, causes a loss of the quality of data consistency, and may make it impossible to analyze such data manually or with the traditional data management systems (Caspari- Sadeghi, 2023; Taylor, et al., 2023; Al-Hemyari and Al Sarmi, 2022; Tasmin, et al., 2020).

The above facts clearly reveal to us that Higher Education generally lacks a decision-making process based on big data that would enable them to benefit and employ the benefits and the potential of big data due to weak computer infrastructure and weak human capabilities (ibid).

It is important for analysts to understand that the data collection is not an end in itself, but rather a tool that allows us to measure what is happening in the HEIs. This requires us to be very careful, and to look towards collecting comprehensive data; and another thing is to know the appropriate techniques and methods for analyzing the data sets and to discover what is involved in the data sets (Taylor, et al., 2023; Al-Hemyari and Al Sarmi, 2023; Hassna, 2022; Nguyen, et al., 2020; Bendermacher et al., 2017).

It is well-known that the multidimensional evaluation method and big data analytics requires participation of various stakeholders, such as the administrative staff, academic staff, students, and others, to participate in various online platforms, and other communication tools and applications so as to express their opinions related to the various activities of HEIs; and then they form the HEIs data sets, which will be subject to various methods of analysis based on statistical theory (Al-Hemyari and Al-Rajihi, 2022; Tasmin, et al., 2020).

The HEIs are major contributors and active participants in the social, economic, and cultural activities and programs in their societies; and as such, they are pioneers in scientific and research activities and programs and innovations in their countries, and indeed of the world.

As a result of changing the roles of HEIs and the emergence of the principles of accountability at various levels, from national to global, and the spread of principles and systems of quality practices, and in the context of achieving the sustainability of higher education, and diversification of educational systems and programs, several new responsibilities of Higher Education Institutions have been developed (Bendermacher et al., 2020& 2017; Baig, et al., 2020; Dzimi'nska et al., 2020; Salvioni et al., 2017; Cortese, 2003).

In addition, the emergence of a clear and growing interest in society and the national bodies concerned, the HEIs like assuring the transparency, the quality of the programs offered in HEIs, and the satisfaction of the stakeholder (students and academic and nonacademic staff and higher bodies) of the HEIs (Al-Hemyari and Al-Rajihi, 2022).

As a result, many national and international competitions between HEIs, and different evaluation techniques between the HEIs have emerged. These have required an active participation of Higher Education Institutions in such activities for the purpose of presenting their results, and to show the level of achievement of their policies and goals in order to enhance the community satisfaction with these institutions, and to enhance their academic reputation (NSS, 2020; FSSE, 2020; AUSSE, 2020; NSSE, 2019; HEA, 2014).

At the present time, most of HEIs in the world have been developing and implementing the multidimensional evaluation method and statistical indicators through many internal mechanisms and projects for the purpose of assessing the performance of HEIs, achieving the goal of internal accountability over their activities, identifying effective teaching and learning practices, strengthening the research activities and outcomes, and developing the institutional environment; at the same time they are achieving the above requirements of accountability, quality and transparency (Al-Sarmi, and Al-Hemyari, 2014 a and b).

Moreover, "the HEIs believe in the importance of the process of surveying the opinions of its stakeholders for the purpose of achieving the continuous quality improvement through the above threes factors, and for assessing the institutional effectiveness and service quality as these are highly beneficial for developing the institutions and related activities and processes" (Al-Hemyari and Al Rajhi, 2022; p.2).

This means that the justification and the need for such a paper is related to the actual need for HEIs and how they demonstrate the level of fulfilling their declared objectives, and the extent to which they show the effectiveness of their activities to the local community to gain the satisfaction of their target populations (Sofroniou, et al., 2020; Alenezi, 2018; Al-Hemyari and Al-Sarmi, 2017; Belarbi, et al., 2016; and Alghamdi, et al., 2016).

The HEIs in all countries of the world are following a clear path in improving the quality of the academic programs which they offer, resources, outcomes, and output by taking many decisions, pursuing various policies, and adopting several actions and procedures. This is also confirmed by the directives issued by the international and national institutional bodies, such as UNICEF, the European Union, and the ministries which emphasize the achievement of the quality of all educational processes and so ensure the quality of output that meet the increasing flow of students to higher education.

The international and national institutional bodies have developed many proposals, models, and several standards for the quality so desired, and advised the HEIs to follow them. In addition, many HEIs, both local and international, have adopted several competitive marketing strategies. Examples of competitive marketing strategies of HEIs are many, such as: "having lower tuition fees than competitors; close links with industry; accreditation from professional bodies; expanding the range of territorial services; tolerance to culture, traditions, values of different cultures; …" (Naudé and Ivy, 1999; Mushketova, et al., 2018 and Olga, et al., 2021). In modern times, and due to the above reasons, the HEIs have assumed and practiced many responsibilities and intervened in all the details of teaching and learning processes, from contracting qualified academic and non-academic staff, taking on the responsibility of training, and preparing the academic and non-academic staff for the various routine duties, specific and specialization procedures and policies of the institutional work, and providing all the necessary resources, supplies, laboratories, classrooms and buildings, ... etc. (Baig, et al., 2020; Szramek and Wolniak, 2020; Brand and Millard, 2019; Eastcott, et al., 2004).

In addition, the HEIs considered other necessary policies and procedures for internal auditing, assessing the performance, and setting targets for future development, and providing all the needs for guaranteeing high achievement of professional and technical skills for all the academic and non-academic staff, in order to attain to high quality teaching and learning, and so graduating skilled students with high levels of competencies (ibid).

It is well known that the process of teaching and learning are holistic interrelated processes which depend on multidimensional factors. These overlap with processes outside of the classroom also. Generally, this process is difficult to evaluate, but it can be evaluated through many different factors and procedures that help students to learn effectively, and so help them to achieve their educational goals (Yáñez de Aldecoa et al., 2022; Kleimola and Leppisaari, 2022; Khahro and Javed, 2022; Brand and Millard 2019; Kupriyanova, et al., 2018; Daniel, 2014; Eastcott, et al., 2004).

The aim of this paper is to develop the multidimensional evaluation method for assessing the performance of HEIs through learning analytics, academic analytics, and analytics of other dimensions of HE in order to discover the level of participation of the academic staff in the teaching and learning processes and other institutional activities. In addition, multidimensional factors and indicators related to those processes, such as participation in classrooms, examination strategies and various scientific and cultural activities are likewise considered. In addition, the paper includes the results of assessment of the level of educational systems of the University of Nizwa (UoN) related to these processes, and an assessment from their point of view of the various services provided by the UoN. The paper also answers the research questions which are given in Section 3.

In other words, this paper shows an overview of the multidimensional evaluation method of the teaching and learning systems of any HEI; UoN is taken as a case study through the learning analytics, academic analytics, and analytics of other dimensions of HE. In addition, the UoN develops in each year a number of electronic surveys directed to the stakeholder/beneficiaries - each survey containing several dimensions and indicators related to the performance of the HEIs. However, in this paper the analytics of the developed indicators and the results of the academic staff's opinion are to be given. It may be noted that the analytics are done using IBM SPSS Statistics -22.

In this paper the model of the multidimensional evaluation method type of assessing the HEIs consists of teaching and learning and those related to academic staff are to be studied and evaluated on the basis of academic staff's opinion; and among those factors the following are to be assessed: Mission, Vision and Values; Governance and Management of the Unit: Governance and Management of the institution; the e-Management Systems; Ethics and Code of Conduct; Teaching Workload; Quality Teaching and Learning Management System; Teaching and Learning Facilities; Academic Advising; Research and e-Research Management System; Registration and Records; Library Resources and Services; Information System Services; Professional Development; Human Resources Department; Work Environment; Chemical and Biological Safety; Healthcare; Hygiene and Security; Media and Marketing; Public Relations; Entrepreneurship Center and Campus Services.

A number of sections have been proposed in this paper which has produced the structure of this paper. It can be said that the paper includes 11 sections, which are as follows: the introduction, related literature and justification are to be given in Sections1 and 2 respectively. In Section 3 the objectives are stated, and in Section 4, the research questions are explained. In Section 5, the methodology is explained. In Section 6 the results of testing the questionnaire are reported. The practical results are described in Section 7; in Section 8, and the results of hypothesis testing are demonstrated. The discussions of the paper are summarized, and the recommendations and conclusions are given in Sections 9 and 10 respectively. Finally, the limitations and future directions are summarized in Section 11.

## 2. The Justifications

As we have mentioned in the last Section, the UoN is developing, as any international HEI is developing in each year, an electronic survey; and the justifications of developing these surveys are:

i. As a general justification of this paper, the international HEIs believe in the process of the multidimensional evaluation method and surveying the opinions of their stakeholders concerning the quality of the institutional services provided to them - teaching and learning and various activities and processes of HEIs, and that the analyses of these opinions are not only of importance but also highly beneficial for developing the HEIs and their various activities and processes; and the UoN has been following this practice.

ii. They are very effective tools for providing the learning and academic analytic and analytic of other dimensions of quality and performance of HEIs (Al-Hemyari and Al Sarmi, 2023).

iii. The aim of the survey has the same international aim and is very much in alignment with one of the international issues of universities – namely, how to improve the level of services offered to their students.

iv. These surveys usually provide data for several research interests which belong to a large domain of international research fields which are called the "performance measurements" of organizations; several authors (for example see, Oufkir et al., 2017; Lyu et. al., 2016) have mentioned several significant reasons why this research field is indispensable for any organization.

v. Also, "the process of the multidimensional evaluation method of the performance is considered one of the key elements of strategic management in their being able to identify the gap between the current situation of an organization and the level of excellence to be considered -this being achieved by proposing goals that are aligned with strategic planning and the use of indicators" (Dickel and de Moura, 2016, p.212).

vi. Several reasons exist for the national needs; The Education Strategy – 2040 (2014) of Oman proposed several recommendations for all HEIs in Oman, some of which are "in order to propose and implement the efficient educational policies in HEIs, such policies should be based on facts, namely, accurate information and statistical indicators" (pp. 10, ibid) and ii. "Developing techniques, criteria and indicators to

assess the opinions of academic staff and students regarding the institutional facilities of institutions" (p. 12, ibid). Thus, this research is to be considered in the light of the above recommendations, which is the second reason for doing this research.

vii. The interior auditing of the quality of teaching and learning and the interior auditing in general are among the most important of an HEI's functions. The interior auditing of teaching and learning can be done specifically through surveying the opinions of academic staff and students. Such practices have several positive effects on the reputation of the HEI in particular and upon society in general. They greatly reinforce the university's reputation and thus make it is one of the students' reasons for future study there. (see, Houston, 2008; Seyfried and Pohlenz, 2018).

viii. To reinforce the academic reputation of the UoN through improving the level of services which have the most significant impact on national and international students.

## 3. The Objectives

The objectives of this are many and to be explained herein. The following objectives are outlined for this paper [to]:

- propose a multidimensional evaluation model for assessing the performance of HEIs.
- select the dimensions of the model and split each dimension to a number of indicators.
- propose a survey to assess the dimensions/indicators of assessing the UoN.
- draw the research questions and give the answers.
- discuss the methodology of the paper.
- examine the reliability measures of the survey.
- explain the data collection.
- examine the learning analytics, academic analytics, and the analytics of other dimensions of the quality.
- testing the statistical significance of the results.
- draw the discussion of the results.
- draw the recommendations, conclusions and limitations and the future research studies.

## 4. Research Questions

The research questions for any project/research are very important because by placing them, it is clarified precisely what the researcher is trying to discover from the research processes and the performance of the factors, variables, and data of the research - the research questions will lead most of the steps in implementing the research. Thus, a few research questions are developed in this report. They are:

1. How good are the reliability and consistency measures of the questionnaire?
2. How well have our university/colleges/centers/directorates offered academic services to academic staff?
3. How well have our university/colleges/centers/directorates offered efficient educational management systems to academic staff?
4. How well have our university/colleges/centers/directorates supported the process of improving the curriculum development.
5. How well have our university/colleges/centers/directorates supported the process of understanding students' learning abilities and challenges.
6. How well have our university/colleges/centers/directorates supported the process of improving instructor performance.
7. How well have our university/colleges/centers/directorates supported the process of developing an effective course curriculum.
8. How well have our university/colleges/centers/directorates supported the process of maximizing the value of teaching resources.
9. How well have our university/colleges/centers/directorates supported the process of maximizing the value of training resources.
10. How well have our university/colleges/centers/directorates supported the process

of maximizing the value of research resources.

11. How well have our university/colleges/centers/directorates supported the process of creating accurate strategic plans.
12. How well have our university/colleges/centers/directorates offered management services to academic staff?
13. How well have our university/colleges/centers/directorates offered other services to academic staff?
14. What can we learn from academic opinions regarding the limitations and obstacles that may prevent them from the benefits of the institutional services?
15. How significance are the results of learning and academic analytics; management systems and analytics of other dimensions of quality and performance?

## 5. Methodology

The research which is contained in this paper is based on the practices of the University of Nizwa, which itself is based on directing electronic surveys to the population of the UoN. No conditions were set for participating in the surveys.

The practice of this paper and its methodology is based generally on the reference framework of assessing the quality of teaching and learning using the Multi-dimensional Evaluation Method, and the teaching and learning systems and related activities of the UoN. In addition, the above reference framework is based on international practices of quality, international bodies like NSS, 2020; FSSE, 2020; AUSSE, 2020; NSSE, 2019; HEA, 2014, …, national recommendations and guidelines, Oman Academic Accreditation Authority, and the UoN polices and the principles of the UoN governing body.

Specifically, and briefly, the methodology of this paper includes seven main aspects:

i. The first of these was the reviewing process of most relevant literature in the Multidimensional Evaluation Method for the performance and quality of HEIs, learning analytics, academic analytic and analytic of other dimensions of HEIs, in order to select the important and common institutional strategies (dimensions) for the purpose of assessing the performance of HEIs (see, Table 7.1).

ii. The second aspect is to select the evaluation criteria which are chosen by dividing the Multi-dimensional institutional strategies (dimensions) into a number of clear and purposeful indicators, which would give accurate and at the same time easy and interpretable evaluation results. It may be mentioned here that the step utilizes the national framework of assessing the performance/quality of teaching and learning; and teaching and learning systems and related activities of the UoN; and the existing practices of FSSE, AUSSE, NSS, FSSE, NSSE, …etc (see, Tables 7.2 to 7.22).

iii. The second was designing the survey based on the framework of assessing the performance/quality of teaching and learning, their teaching and learning systems and related activities of the UoN. It may be mentioned that the six Likert Scale from Strongly Disagree to Strongly Agree is developed to measure the performance of each indicator in the survey. It may be worth noting that each indicator is translated to one question of the survey.

iv. Reviewing the proposed surveys by several experts. In addition, testing and piloting the proposed survey; and the groups of measures of “Cronbach's Alpha”, “Cronbach's Alpha if Item Deleted”, “Split Half Reliability” and “Guttman Reliability” are computed and studied in this paper and studied.

v. The population, sample and data collection: as the survey contains 156 qualitative indicators, it is usually for such a case we have to collect the data for the qualitative indicators from the target population, i.e. the data collection process being based mainly on collecting qualitative data from the academic staff by circulating various surveys to them. In addition, the questionnaires are used as a tool for collecting the primary data in this study. The population size of the academic staff is 400, and the completed questionnaires of the surveys were 304. The questionnaires were implemented and distributed electronically, i.e. they were forwarded to all academic staff of the UoN electronically for the period of one month (time frame). At the end of the timeframe the data was collected, and we observed that the total of completed surveys was 304 which constitutes the sample size of the study, i.e. the study includes about 75% of the population of the academic staff.

vi. The data editing/cleaning stage is developed to reduce the non-sampling error of the data. In order to minimize the non-sampling error, a number of steps were taken (Giudici, 2003):

- the objectives of the surveys are well articulated in the UoN,
- the respondents were informed that they must believe that their opinions which are expressed in these surveys will be appreciated by the UoN and will be included and taken into account in subsequent decisions and future plans,
- defining the indicator's and survey's concepts and interests to all academic staff;
- loading the data on different computers to find out the mistakes/differences between them. And in order to minimize the personal variations due to misunderstanding, a glossary of the survey is explained to all respondents.
- cross checking and additional detecting and cleaning techniques were also performed.

vii. The analysis and testing of the data are done in this paper. The data analysis is a global practice that we may find in reports of all Higher Education Institutions of the world. In addition, the calculation of all the indicators and testing the significance of the results are explained thoroughly in Sections 7 and 8. The percentages, averages and weighted averages of each statistical indicator were calculated based on the data collected. It may be noted that the analytics are obtained using IBM SPSS Statistics -22. In addition, the results were tested using various statistical tests, in order to check the significance and the accuracy of the results.

Remark 1: It is well known that any process of data collection is affected by different types of statistical error. In fact, there are two types of statistical error (sampling and non-sampling) that occur in any experiment, and which are caused by many factors. These affect the data - the estimation results therefore need to be controlled.

A sampling error occurs as a result of making inference or estimation from a sample of observations rather than from the whole population. The high sample ratio (as in this paper) from the population was considered as a means by which the sampling error could be reduced.

Remark 2: In this paper, high attention is paid in studying, reviewing, and piloting the proposed surveys; and the developed simple and accurate statistical analysis and testing techniques of the data/ results were chosen carefully in order to get accurate conclusions and to benefit from the availability of the big data set. In addition, the above actions are aligned with the famous advice "the size of the data does not remove the need for appropriate study design and statistical analysis" (Cox, et al., 2018; p.114).

As it is known, the evaluation of HEIs must be carried out through many educational and academic processes, activities, management systems, and output, results, and scientific products. So, the paper includes many educational, learning, and academic processes, activities, management systems, and output, results, and scientific products.

## 6. Testing the Questionnaire

As it is known, the Cronbach's Alpha is one of the important statistical measures that researchers rely on extensively, in order to prove that these tools or surveys, or the scales of measurement that have been proposed or adopted in various research papers or projects for the purpose of collecting data on the problem of the research projects are suitable and consistent [Cronbach and Shavelson (2004), Osburn (2000), Bendermacher (2010), Douglas and Wright (2015) and Taber (2016)]. In addition, the Cronbach's Alpha Reliability describes the reliability of a sum (or average) of q measurements where the q measurements may represent q raters, occasions, alternative forms, or questionnaire/test items" (Douglas and Wright, 2015; p. 1).

At the present time, there are several statistical measures developed by different authors in order to assure the reliability and consistency of developed tools or surveys, or the scales of measurement. Some of which are: Cronbach's Alpha, Cronbach's Alpha if Item Deleted, measures of "Split Half Reliability" and measures of the "Guttman's

Reliability" (Al-Hemyari and Al-Rajhi, 2022a and b). In this paper and in order to answer the first research question, the four groups of measures of reliability and consistency are developed for the survey of academic staff based on the opinions of 50 academic staff; and some of the results of these measures are to be given and discussed in this Section. The first result estimated measure based on the above sample is the "Cronbach's Alpha" which is equal to 0.913; and the results of the second measure "Cronbach's Alpha if Item Deleted" ( $\rho$ ) are given in Table 1 below. Table 1 shows that the values of this measure are excellent and ranging from 0.907 to 0.923, i.e. no need to delete any indicator.

Table 1: Shows some values of the "Cronbach's Alpha if Item Deleted" ( $\rho$ )

| Indicators | $\rho$ | Indicators | $\rho$ | Indicators | $\rho$ | Indicators | $\rho$ |
|---|---|---|---|---|---|---|---|
| VAR1 | 0.907 | VAR14 | 0.908 | VAR27 | 0.907 | VAR40 | 0.907 |
| VAR2 | 0.909 | VAR15 | 0.915 | VAR28 | 0.909 | VAR41 | 0.912 |
| VAR3 | 0.91 | VAR16 | 0.907 | VAR29 | 0.908 | VAR42 | 0.91 |
| VAR4 | 0.918 | VAR17 | 0.909 | VAR30 | 0.916 | VAR43 | 0.907 |
| VAR5 | 0.909 | VAR18 | 0.908 | VAR31 | 0.907 | VAR44 | 0.918 |
| VAR6 | 0.909 | VAR19 | 0.916 | VAR32 | 0.912 | VAR45 | 0.907 |
| VAR7 | 0.908 | VAR20 | 0.912 | VAR33 | 0.914 | VAR46 | 0.909 |
| VAR8 | 0.917 | VAR21 | 0.915 | VAR34 | 0.92 | VAR47 | 0.908 |
| VAR9 | 0.907 | VAR22 | 0.923 | VAR35 | 0.906 | VAR48 | 0.916 |
| VAR10 | 0.919 | VAR23 | 0.917 | VAR36 | 0.913 | VAR49 | 0.907 |
| VAR11 | 0.917 | VAR24 | 0.915 | VAR37 | 0.907 | VAR50 | 0.909 |
| VAR12 | 0.907 | VAR25 | 0.908 | VAR38 | 0.916 | VAR51 | 0.908 |
| VAR13 | 0.908 | VAR26 | 0.916 | VAR39 | 0.91 | VAR52 | 0.916 |

The results of the third group measures called "Split Half Reliability" are: "Cronbach's Alpha" of first part equals to 0.743; "Cronbach's Alpha" of second part equals to 0.880; the Correlation Between the two parts equals to 0.925; the "Spearman-Brown Coefficient" equals to 0.961; and the "Guttman Split-Half Coefficient" equals to 0.917.
Finally, the results of the fourth group of "Guttman's Reliability" are given in terms of six lower bounds denoted by $\lambda_i, i = 1,2, \dots, 6$; which are equal to 0.896, 0.957, 0.913, 0.917, 0.928, 0.935 respectively.It may be noted that the satisfactory results of any measure of the above 13 measures should be greater than or equal to 0.7 [Cronbach and Shavelson (2004), Osburn (2000), Bendermacher (2010), Douglas and Wright (2015), Taber (2016) and Al-Hemyari and Al-Rajhi, 2022a and b]. Thus, all the above results are satisfactory and there is no need to develop any modification to the academic survey.

## 7. Practical Results

As it is known that the evaluation of HEIs must be carried out through the Multi-dimensional Evaluation Method, i.e., several institutional dimensions like the learning and academic processes, activities, management systems, output, results, and scientific products, so, this paper includes the results of 22 dimensions and 156 indicators related the above issues and based on academic staff opinion. It may worth mentioning that the Table 2 shows the level of achievement of each dimension. It may be noted that the results are obtained using IBM SPSS Statistics -22.
In order to answer the research questions from 2 to 14 given in Section 4, the overall level of achieving each dimension of the academic staff opinions was computed and given in Table 2 below.

**Table 2 The level of achieving each dimension of the model.**

| | Dimension | Ratio | Level |
|---|---|---|---|
| 1 | Mission, Vision and Values | 0.965 | Excellent |
| 2 | The Governance and Management of the Unit | 0.896 | Very Good |
| 3 | The Governance and Management | 0.975 | Excellent |
| 4 | The Effectiveness of the e-management Systems | 0.975 | Excellent |
| 5 | The Ethics and Code of Conduct | 0.998 | Excellent |
| 6 | The Teaching Workload | 0.900 | Excellent |
| 7 | The Quality Teaching and Learning Management System | 0.921 | Excellent |
| 8 | The Teaching and Learning Facilities | 0.892 | Very Good |
| 9 | The Academic advising | 0.952 | Excellent |
| 10 | The Research and e-Research Management System | 0.962 | Excellent |
| 11 | Deanship of Registration and Records | 0.984 | Excellent |
| 12 | Library Resources and Services | 0.967 | Excellent |
| 13 | The Center for Information System Services | 0.972 | Excellent |
| 14 | The Professional Development | 0.970 | Excellent |
| 15 | The Human Resources Department | 0.978 | Excellent |
| 16 | The Work Environment | 0.971 | Excellent |
| 17 | The Health and Safety | 0.928 | Excellent |
| 18 | The Chemical and Biological Safety | 0.966 | Excellent |
| 19 | The Risk Management System & e-RMIS (e-Risk Management Information System). | 0.980 | Excellent |
| 20 | The Services provided by the Entrepreneurship Center | 0.990 | Excellent |
| 21 | The services provided by the Center for Consultancy Services & Innovation Transfer (CCSIT) | 0.959 | Excellent |
| 22 | The Campus Services | 0.959 | Excellent |

Table 2 above shows the performance of all the activities done by the Department/Directorates/Deanships/Colleges of the UoN based on academic staff opinions is high (20 dimensions are excellent and 2 dimensions are very good) as expected, and this means that the UoN satisfied its goals based on the opinions of academic staff.
Remark 2: The main dimensions given in Table 2 were split into 156 indicators above and studied comprehensively. In addition, the calculations and results of the 156 indictors were not given, in order to save space.

## 8. Testing the Results

In order to answer the last research question (How significant are the results of learning and academic analytics; management systems and analytic of other dimensions of quality and performance?), and to assure accuracy of the opinions of the academic staff, the non-parametric testing of hypotheses has to be developed. It is well known that "the non-parametric tests (like one-sample Wilcoxon signed rank) is an alternative to one-sample t-test when the sample sizes are small, i.e. not following the normal distribution" (Al-Hemyari and Al-Rajhi, 2022a). In this paper 22 hypotheses which are equivalent to the dimensions of the survey have been developed in order to answer the last research question and to assure accuracy of the opinions of the academic staff; the required hypotheses are given by:

$H_{0i}$: the median (m) of the academic staff′s responses of ith dimension = the theoretical value $(m_0)$, i $= 1,2, \dots 22$;

$H_{1i}$: the median (m) of the academic staff′s responses of ith dimension ≠ the theoretical value $(m_0)$, i $= 1,2, \dots 22$.

In this section, the results of testing the dimensions (D) of the Academic Staff Survey in the above hypotheses using one-sample Wilcoxon signed rank test, and the sig. value of each test ($p$) are given in Table 3 below.

Table 3: The results of significant (Sig.) value $p$ of testing the dimensions

| D | $p$ | D | $p$ |
|---|---|---|---|
| D1 | 0.042 | D12 | 0.002 |
| D2 | 0.028 | D13 | 0.014 |
| D3 | 0.011 | D14 | 0.012 |
| D4 | 0.066 | D15 | 0.008 |
| D5 | 0.018 | D16 | 0.011 |
| D6 | 0.018 | D17 | 0.008 |
| D7 | 0.019 | D18 | 0.043 |
| D8 | 0.018 | D19 | 0.028 |
| D9 | 0.001 | D20 | 0.003 |
| D10 | 0.002 | D21 | 0.012 |
| D11 | 0.003 | D22 | 0.001 |

The above table shows that the sig. values of all dimensions are less than 0.05; this means that we reject the null hypotheses $H_{0i}$ , $\mathrm{i} = 1,2, \ldots 22;$ it shows that the ratings of academic staff to all dimensions are significant.

## 9. Discussion

In this paper the research problem, its importance, justification, the objectives, the expected benefits of the research problem for any HEI are discussed. In addition, the research questions are laid out, the methodology is designed, the techniques for assessing the survey, and the practical results are analyzed and studied, and the statistical tests for assessing the significance of the results are given.

In this paper a multidimensional evaluation model for assessing the performance of HEIs is proposed; 15 research questions were developed and answered, and each dimension has included several indicators, and a survey containing all the dimensions and indicators is proposed, piloted and studied. In addition, it is really interesting to observe that the related level of the results of each research question are either very good or excellent. It may be mentioned here that each indicator/dimension has been calculated, analyzed, and studied. Some of the main results of Academic Staff Surveys will be highlighted and discussed in this section,

i. Most of the opinions of academic staff on the related indicators/dimensions show high results.
ii. It may be mentioned here and based on the results of academic staff's opinions that the process of the services of Records and Registration in the UoN has been developed and then implemented by the Deanship of the Services of Records and Registration with a high degree of professionalism to help the students in achieving their educational goals.
iii. The academic staff's opinions on healthcare, hygiene, and security dimension show that the procedures used at the University of Nizwa to satisfy the principles of healthcare, hygiene and security are excellent.
iv. The opinions of academic staff regarding the campus climate clearly indicate a very good level of "the real or perceived quality of interpersonal, and engagement" of the students.
v. The academic staff opinions regarding assessing the dimension of the Mission, Vision and Values of the UoN show a very high awareness regarding the Mission, Vision and Values.

vi. The opinions of academic staff of assessing the dimension of the governance and management of the UoN show an excellent level of awareness to the governance and management of the UoN.
vii. It is very clearly based on the academic staff opinions that the functions of the teaching and learning quality management systems of the UoN are applied properly and efficiently.
viii. It may be mentioned here and based on the academic staff opinion of the process of the academic advising in the UoN that it is shown that the processes of the academic dimension have been developed and then applied with a high standard of professionalism which helps the students to achieve their educational goals.
ix. Based on the results of the Academic Staff Survey the statements/indicators regarding the functions of the Center for Information Systems of the UoN it is shown that the Center for Information Systems has developed its duties to a high standard of professionalism which supports the academic staff, which in turn helps them achieve their academic goals.
x. The opinions of academic staff regarding the work environment of UoN clearly indicate that the work environment is healthy and attains to a good psychosocial environment.
xi. The academic staff opinions on the health and safety dimension show that the health protocols used at the University of Nizwa to prevent infectious diseases and pandemics are excellent and have a positive impact on the academic staff health.
xii. Based on the results of the Academic Staff Survey opinions, it is shown that the e-RMIS has satisfied its functions properly.
xiii. The opinions of the academic staff regarding the campus climate clearly indicates a very good level of "the real or perceived quality of interpersonal, and engagement" of the academic staff.

## 10. Recommendations and Conclusions

In general, this study proposed a multidimensional model to evaluate the institutional strategies based on splitting/aligning each dimension with a number of indicators. In addition, this model was reached by reviewing many international studies and conducting many analyzes and tests to confirm the effectiveness of the model and its multidimensions and 156 indicators.

Also, the statistical analyses of the collecting a big data set and computations showed a positive result on a large scale and in all dimensions and indicators, which reflects the various events and activities implemented at the UoN. In addition, the results indicate that the UoN has devoted all its capabilities to serving the teaching process and supporting students in achieving their educational goals, and also supporting the academic staff achieve their academic goals.

The results reviewed in the previous sections show a very good or excellent level of the achievement of each activity or process of the teaching and learning, the level of effectiveness and efficiency of the administrative and educational systems, and the level of achievement and presentation of various services to the academic staff through the results of the many indicators. Through these results, we can ensure that students succeed in achieving their educational goals.

The same results also confirm the concerted efforts of the academic and functional staff to enhance the opportunities for students' development and improvement of their results. The study also enables the possibility of providing appropriate support from academic staff to help the weak students who may require additional support, such as counselling, and to formulate the student plans to achieve a good standard of individual learning.

At the same time, the results are very useful for the UoN, colleges and academic departments, and for all other departments which provide the UoN with the bases and requirements of taking the necessary academic decisions for the next year regarding all teaching processes and the level of services provided to students, academic and non-academic staff.

It may be worth mentioning that the process of collecting the opinions of the academic staff has succeeded and produced high-accuracy data. Also, the results of data analysis are excellent and significant.

## 11. Limitations and Future Directions

It may be useful to clarify that there is no work without challenges or obstacles, especially in HEIs. One of the most important challenges of the study is the level of participation of the academic staff in the survey; this obstacle was overcome through using several advertisements directed to the academic staff, which gives high ratio of participation and positive responses.

One of the most critical challenges faced by the studies of the performance of HEIs is the size of the data and the large number of survey options, which leads to the difficulty of accurate analysis and in deriving the results from the analysis. Despite this (the extent of this problem is neglected), the analysis was carried through and completed and adequately interpreted, and some important results were drawn from the analysis.

It is also necessary to mention that the surveys should be carried out at a suitable time for academic staff; they should not be carried out during exam times so that the academic staff should not have the stresses of exams unduly influencing their opinion. Therefore, surveys were carried out and data collected before the final exam time.

Finally, the last challenge is that the teaching process and support systems are constantly evolving, so our surveys must be developed from year to year, and this is what actually happens every year.

Regarding the future research directions, some other indicators need to be included in coming surveys – such as: the amount of learning, the variety of teaching methods, the level of interaction between academic staff, and between the academic staff and students, and the level of engagement with the society.

**Conflict of interest:** On behalf of all authors, the corresponding author states that there is no conflict of interest.

## References

1. Alenezi, A. (2018) 'Barriers to Participation in Learning Management Systems in Saudi Arabian Universities'. *Education Research International*, Volume 2018 , Article ID 9085914, pp.1-8, | https://doi.org/10.1155/2018/9085914
2. Alghamdi, W.M., Markoulli M, Holden BA, Papas EB. (2016) 'Impact of duration of contact lens wear on the structure and function of the meibomian glands', *Ophthalmic and Physiological Optics*, Vol.36, No.2, pp.120-31. DOI: 10.1111/opo.12278
3. Al-Hemyari, Z.A. and Al-Rajihi, Z. (2022) 'How can we develop academic and student surveys to measure and evaluate the quality of services at higher education institutions? Insights from a non-profit HEI in the Sultanate of Oman', *International Journal of Quality and Innovation*, Vol.6, No.2, pp.134 – 161.
4. Al-Hemyari, Z. A. and Al-Sarmi, A.M. (2017) 'HEIs Quality Improvement Through Students and Academic Staff's Perception: Data Analysis and Robustness of the Results' *International Journal for Quality Research*, Vol.11, No.2, pp.261-278.
5. Al-Sarmi, A. M. and Al-Hemyari, Z. A. (2014a) 'Quantitative and qualitative indicatorsto assess the performance of higher education institutions' *International Journal of Information and Decision sciences*, Vol.6, No. 4, pp.369-392.
6. Al-Sarmi, A. M. and Al-Hemyari, Z. A. (2014b) 'Statistical characteristics of performance indicators' *International Journal of Quality and Innovation*, Vol.2, No.3-4, pp. 385-309.
7. AUSSE (2020) 'The Australasian Survey of Student Engagement'[online]. https://research.acer.edu.au/ausse/
8. Baig, M.I., Shuib, L. & Yadegaridehkordi, E. (2020) 'Big data in education: a state of the art, limitations, and future research directions', *International Journal of Educational Technology in Higher Education*, Vol.17, No.44, pp.1-23.
9. Daniel, B. (2014) 'Big Data and analytics in higher education: Opportunities and challenges'. *British Journal of Educational Technology: Open Data in Learning Technology*, Vol.46, Iss.5, pp. 904-920.
10. Belarbi, A.K., El-Refae, G.A., Ballard, J.A. and Abu-Rashed, J. (2016) 'Transnational education in the Gulf
11. Cooperation Council countries: the challenges of internationalisation and quality in higher education', *Int. J. Economics and Business Research*, Vol. 11, No. 2, pp.120–131.

12. Bendermacher, G. W.G.; De Grave, W. S.;. Wolfhagen, I.H.A.P;. Dolmans, D. H.J.M, and Egbrink, M. G.A. (2020) 'Shaping a Culture for Continuous Quality Improvement in Undergraduate Medical Education. Academic Medicine', Vol. 95, No. 12, pp.1913-1920.
13. Bendermacher, G. W.G.; De Grave, W. S.;. Wolfhagen, I.H.A.P;. Dolmans, D. H.J.M, and Egbrink, M. G.A. (2017) 'Unravelling quality culture in higher education: a realist review', *Higher Education*, Vo. 2017, No. 73, pp.39–60.
14. Bendermacher, N. (2010) 'Beyond Alpha: Lower Bounds for the Reliability of Tests', *Journal of Modern Applied Statistical Methods*: Vol. 9, No. 1, pp.95-102.
15. Brand, S., & Millard, L. (2019) 'Student engagement in quality in UK higher education: more than assurance?' In Tanaka, M. (Ed.), Student engagement and quality assurance in higher education: international collaborations for the enhancement of learning (pp. 35-46). Routledge. https://doi.org/10.4324/9780429025648-4
16. Campbell, J.; De Blois, P. and Oblinger, D. (2007) 'Academic Analytics: A New Tool for a New Era', EDUCAUSE Review, Vol. 42, No. 4, PP. 40–57.
17. Caspari- Sadeghi, S. (2023) 'Learning assessment in the age of big data: Learning analytics in higher education', *Cogent Education*, Vol. 10, Iss. 1, pp.1-11.
18. Chaurasia, S. S., Kodwani, D., Lachhwani, H., & Ketkar, M. A. (2018) 'Big data academic and learning analytics', *International Journal of Educational Management*, Vol.32, No.6, pp.1099–1117. https://doi.org/10.1108/ijem-08-2017-0199.
19. Cortese, A. (2003) 'The critical role of higher education in creating a sustainable future', *Planning for Higher Education Journal*, Vol. 31, No.3, pp.15–22.
20. Cox, D.R., Kartsonaki, C, Keogh RH. (2018) 'Big data: Some statistical issues', *Statistics & Probability Letters* 136, Iss. May, pp.111-115. doi: 10.1016/j.spl.2018.02.015.
21. Cronbach, L. J. and Shavelson, R. J. (2004) 'My current thoughts on coefficient alpha and successor procedures', *Educational and Psychological Measurement*, Vol. 64, No. 3, pp.391-418.
22. Dickel, D.G. and de Moura, G.L. (2016) 'Organizational performance evaluation in intangible criteria: a model based on knowledge management and innovation management', *RAI Revista de Administração e Inovação*, Vol. 2006, No.13, pp.211–220.
23. Douglas, G. B. and Wright, T. A. (2015) 'Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning', *Journal of Organizational Behavior*, Vol.36, Iss.1, pp. 3-15.
24. Dzimi'nska M., Fijałkowska, J. and Sułkowski,L. (2020) 'A Conceptual Model Proposal: Universities as Culture Change Agents for Sustainable Development', Sustainability Vol, 12, No.4635, pp.1-23.
25. Eastcott, A., Brand, S., Wynne, N., and Millard, L. (2004) 'Fostering Innovation and Embedding Change'. In Gil, V., Alarcao, M. I. and Hooghoff, H.: Challenges in Teaching and Learning in Higher Education, University of Aveiro/Portugal and SLO/Netherlands, pp.1-12 [online]. https://cms.ua.pt/editora/?q=node/33
26. FSSE (2020). Faculty Survey of Student Engagement[online] https://nsse.indiana.edu/fsse/
27. Giudici, P. (2003) *Applied Data Mining: Statistical Methods for Business and Industry*. Wiley, John & Sons, Incorporated.
28. Hassna, G. (2022) 'Big Data and Analytics to transform higher education: a value chain perspective',
29. *Perspectives: Policy and Practice in Higher Education*, pp1-9. DOI: https://doi.org/10.1080/13603108.2022.2099475
30. HEA (2014). Higher Education System Performance Framework[online]. https://www.education.ie/en/The-Education-System/Higher-Education/HEA-Higher-Education-System-performance-Framework-2014-2016.pdf
31. Herbert W. and Marsh and Michael Bailey (1993) 'Multidimensional Students' Evaluations of Teaching Effectiveness: A Profile Analysis', *Journal of Higher Education*, Vol. 64, No. 1, pp. 1-18.
32. Houston, D. (2008) 'Rethinking quality and improvement in higher education', *Quality Assurance in Education*, Vol. 16, No. 1, pp.61–79.
33. Khahro, S.H.; Javed, Y. (2022) 'Key Challenges in 21st Century Learning: A Way Forward towards Sustainable Higher Educational Institutions', *Sustainability*, 14, 16080, pp.1-19. https://doi.org/10.3390/ su142316080

34. Khaw, T.Y. and Teoh, A.P. (2023), 'The influence of big data analytics technological capabilities and strategic agility on performance of private higher education institutions', *Journal of Applied Research in Higher Education*, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/JARHE-07-2022-0220
35. Kleimola, R. and Leppisaari, I. (2022). Learning analytics to develop future competences in higher education: a case study. International Journal of Educational Technology in Higher Education, 19:17, pp.1-25. https://doi.org/10.1186/s41239-022-00318-w
36. Kumaravel, V. and Vikkraman, P. (2018) 'Assessment of knowledge management practices in higher educational institutions in India: A Structural Equation Modeling approach', *International Journal of Educational Sciences*, No. 20, Vo.1-3, pp.120-136.
37. Kupriyanova V., Estermann T., Sabic N. (2018) 'Efficiency of Universities: Drivers, Enablers and Limitations' (pp. 603-618). In: Curaj A., Deca L., Pricopie R. (eds) European Higher Education Area: The Impact of Past and Future Policies. Springer, Cham, pp. 1-727.
38. Lesjak, D., Srečko Natek and Frederick Kohun (2021) 'Big data analytics in higher education', *Issues in Information Systems*, Vol. 22, Iss. 4, pp. 320-333.
39. Long, P., & Siemens, G. (2011) 'Penetrating the Fog: Analytics in learning and education', EDUCAUSE Review, pp.31–40 [online].
40. https://er.educause.edu/-/media/files/article-downloads/erm1151.pdf
41. Lyu, H., Zhiying, Z. and Zuopeng, Z. (2016) 'Measuring Knowledge Management Performance in Organizations: An Integrative Framework of Balanced Scorecard and Fuzzy Evaluation', *Information*, Vol.7, No.29, pp.1-11.
42. Metsäpelto, RL., Poikkeus, AM., Heikkilä, M. et al. (2022) 'A multidimensional adapted process model of teaching', *Educational Assessment, Evaluation and Accountability*, Vol.34, pp.143–172. https://doi.org/10.1007/s11092-021-09373-9
43. Mushketova, N., Bydanova, E. and Rouet, G. (2018) 'National strategy for promotion of Russian universities
44. in the world market of education services', *International Journal of Educational Management*, Vol. 32, No. 1, pp. 46-56. https://doi.org/10.1108/IJEM-10-2016-0207
45. Naudé, P. and Ivy, J. (1999) 'The marketing strategies of universities in the United Kingdom', *International Journal of Educational Management*, Vol. 13 No. 3, pp. 126-136. https://doi.org/10.1108/09513549910269485
46. Nguyen, A., Gardner, L., & Sheridan, D. (2020) 'Data Analytics in Higher Education: An Integrated View', *Journal of Information Systems Education*, Vol.31, No. 1, pp.61-71.
47. NSSE (2019) 'National Survey of Student Engagement' [online]. https://nsse.indiana.edu/nsse/survey-instruments/nsse-2013-update.html
48. NSS (2020) 'National Student Survey' [online]. https://www.timeshighereducation.com/student/news/national-student-survey-2020-overall-satisfaction-results
49. Olga, F., Vlada, N. and Sergey, K. (2021) 'The role of Russia in the world education market', *Propósitos Y Representaciones*, Vol. 9, No. SPE(3), e1410, pp.1-11
50. Osburn, H.G. (2000) 'Coefficient alpha and related internal consistency reliability coefficients', *Psychological Methods*, Vol.5, No.3, pp.343-55.
51. Oufkir, L, Mounia F. and Ismail, K. (2017) 'Performance Measurement for KnowledgeManagement: Designing a Reference Model', *Journal of Organizational Knowledge Management*, Vol.2017, No.2, pp.1-13.
52. Salvioni, D.M.; Franzoni, S.; Cassano, R. (2017) 'Sustainability in the higher education system: An opportunity to improve quality and image', *Sustainability*, Vol.9, No.914, pp.1-27.
53. Seyfried, M. and Pohlenz, P. (2018) 'Assessing quality assurance in higher education: quality managers' perceptions of effectiveness', *European Journal of Higher Education*, Vol. 8, No. 3, pp.258–272.
54. Szramek, A.R. and Wolniak, R. (2020) 'Job Satisfaction and Problems among Academic Staff in Higher Education', *Sustainability*, Vol.12, No.4865, pp. 1-38.
55. Taber, K. S. (2016) 'The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education', *Research in Science Education*, Vol.48, No.1, pp.1273–1296.
56. Tasmin, R. , Muhammad, R. N., and Nor Aziati A. H. (2020) 'Big Data Analytics Applicability in Higher Learning Educational System'. IOP Conference Series: Materials Science and Engineering, Volume 917,

International Conference on Technology, Engineering and Sciences (ICTES), from 17 to 18 April 2020, Penang, Malaysia.

57. Taylor, Z.W.; Kugiya, J.; Charran, C.; Childs, J. (2023) 'Building Equitable Education Datasets for Developing Nations: Equity-Minded Data Collection and Disaggregation to Improve Schools, Districts, and Communities' *Education Sciences*, Vol.13, No.4, I.348. pp.1-13. https://www.mdpi.com/2227-7102/13/4/348
58. The Education Strategy-2040 (2014). The Education Council, Oman, 1-117[online]. http://www.educouncil.gov.om/en/page.php?scrollto=start&id=17
59. Wong, B.T.M. (2017) 'Learning analytics in higher education: an analysis of case studies', *Asian Association of Open Universities Journal*, Vol.12, No.1, pp.21-40. https://doi.org/10.1108/AAOUJ-01-2017-0009
60. Yáñez de Aldecoa, Cristina, and Isabel María Gómez-Trigueros (2022) 'Challenges withComplex Situations in the Teaching and Learning of Social Sciences in Initial Teacher Education', *Social Sciences*, Vol.11,
61. No.295, pp.1-19. https://www.mdpi.com/2076-0760/11/7/295