

Consistency, Validity & Homogeneity of General Foundation Programme (GFP) offered at National University Science & Technology, Oman

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Abstract: *The study aims to prove the quality of the general foundation Programme (GFP) offered at National University Science & Technology, Oman. In-consistency in the entry test offered at National University Science & Technology, Oman with various cohort were observed, leading to study and discuss the effectiveness of GFP in National University Science and Technology. This study emphasis and relies on the statistical analysis of data collected. The research focuses on the comparative study between assessment results of an academic year cohort during an entry and exit test with the help of statistical terms such as standard deviation, coefficient of variation, Cronbach's alpha, and Chi Square test to support the claim. Standard deviation and coefficient of variation of entry test results for past four academic year were calculated and was not found in the healthy range, the result showed the in-consistency of the entry test. This triggered the further investigation of checking the level of various cohort while they exit GFP in comparison with their performance in the entry level. The analysis of exit results was very encouraging as the statistical conclusions in standard deviation, coefficient of variation, Cronbach's alpha, and Chi Square test were in the required range, proving the quality of GFP offered at National University Science & Technology. The National Quality Plan 2006, (OAAAQA - General Foundation Programme Accreditation, n.d.) specifies the importance general foundation programme to prepare the students prior to the undergraduate studies which resulted in the development of Oman Academic Standards for General Foundation Programme in guiding the Higher Education Institutions (HEIs) with the structure of the General Foundation Programme to be followed. However, Oman Academic Standards for General Foundation Programme does not specify course delivery strategy and assessment pattern, HEI's can decide their own. As there is no national level delivery strategy and assessment pattern in Oman for GFP, the research recommends the course structure and assessment criteria followed at National University Science & Technology as a national level norm for the general foundation.*

Key Words: *GFP in Oman, Entry & Exit Tests, Consistency, Validity & Homogeneity of GFP.*

1. INTRODUCTION:

As per Oman Academic Standards for General Foundation Programme, the students entering to higher education after finishing the secondary schooling first complete a bridging course called General Foundation Program (GFP) preparing them to acquire academic skills and knowledge required for undergraduate programmes. GFP is mandatory entrance criteria for any undergraduate programmes in Oman. Oman Academic Standards for General Foundation Programme also identifies that the primary aim of higher education institutions (HEI) should be providing a quality general foundation (OAAAQA - General Foundation Programme Accreditation, n.d.). Oman academic accreditation authority (OAAAQA) is responsible for monitoring and ensuring the quality of higher education in Oman including the general foundation. Having said that, Oman academic accreditation authority (OAAAQA) forward standards for GFP (OAAAQA - General Foundation Programme Accreditation, n.d.). These standards are interpreted by each higher education institutions (HEI) into their own course materials and assessment strategies by strictly following the learning outcomes set by Oman Academic Standards for General Foundation Programme.

GFP in Oman focuses on English, Mathematics and Computing Skills as mandatory subjects. However, the HEI's are allowed to include additional subjects based on the majors offered. For example, Engineering colleges can offer Physics at foundation level in addition to the subjects insisted by OAS. In general, the students must appear for an entry placement test designed by the HEI to get admission at the institution. Each HEI's has their own entry placement test mechanism.

Based on the results of the test, the students are categorized at different levels of GFP. Students with IELTS (band 5 and above) and IC3 certificates are eligible for exemption in learning English and Computing Skills respectively in GFP, but not necessarily. As there is no standardized certification, Mathematics is a compulsory subject in all foundation programmes. GFP offered in Oman is one year program. Each subject offered in GFP includes coursework structure and a final exam. The coursework structure, assessment pattern and progression criteria are decided by HEI according to the students' background and offered majors. HEI's design their course delivery strategy and assessment pattern, to achieve the learning objectives set by Oman Academic Standards for General Foundation Programme.

1.1. General Foundation Programme (GFP) at National University Science & Technology:

The General Foundation Programme (GFP) at National University Science & Technology is a two-semester program named as F1 (level 1) and F2 (level 2) which include three courses English, Mathematics & Computing Skills. At the time of admission students are enrolled in F1 or F2 based on the score obtained in a placement test which covers English, Mathematics and Computing Skills. The Mathematics & Computing Skills placement test is prepared in-house, whereas Oxford Placement Test (OPT), an internationally bench marked test is adopted as the English placement test. All students must go through the foundation program, however exemptions from some courses are allowed based on the grade level in the placement test. Moreover, an exemption from English placement test will be given to students is submit an IELTS band 5 or above aiming for engineering undergraduate programmes whereas IELTS band 6 for medicine or pharmacy course (National University, 2024). Both F1 and F2 level courses are composed of course work (CW) and final exam (FE) with an aggregate pass requirement of 50% with a mandatory criterion of 50% requirement separately in course work (CW) and final exam (FE). Further, F3 an English for specific purpose course for Medicine and Pharmacy majors is offered in summer semester covering English, Chemistry and Biology. This is a short-term course which covers the essential pre-requisite for medicine and pharmacy.

At National University, the School of Foundation Studies (SoFS) identifies the core values and graduate attributes as the foundation of student learning experience. To ensure that throughout the educational journey, SoFS trains students to acquire the skills, knowledge, and abilities beyond disciplinary content knowledge. Acquiring these attributes ensures that students are prepared to begin their undergraduate studies. All academic, co-curricular and extra-curricular activities reflect these attributes, but the achievements of these attributes depend on the level of commitment and hard work. General attributes that are embedded into the program are as follows: (National University Science & Technology, n.d.)
Knowledgeable and Competent in the subject area

- Solution Seekers: critical thinkers and researchers with confidence in developing professional solutions
- Lifelong Learners: mastering independent learning skills for career development and professional advancement
- Confident & Adaptive: effective communicators and adopt to emerging technologies and economic scenarios
- Ethical Practice: exhibit high level of professionalism and ethical behavior

An academic advisor is assigned to students ensure academic support from the first semester of study till the end of foundation. The advisor has access to academic, attendance, and behavioral records of advisees, enabling them to assist the students to effectively face their academic issues. At SoFS, the students are invited to seek help for individual difficulties in learning through tutorials with the teachers or through the Student Assistance Program [SAP] where the peers facilitate learning. In addition, faculty members conduct tutorials during publicized office hours based on student needs. If the student has any personal issues affecting their studies and student life, a certified student counselor is available to help them. The Academic Affairs Office will help to book an appointment with the counselor. While the counselor may contact the academic advisor for any information related to the academic performance, the discussion with the counselor remains confidential. The education doesn't stop at the classroom door. At SoFS, the students are encouraged to participate in extracurricular activities to explore their interests, meet new people, and learn new skills. These activities are organized through the Student Affairs Department and Community Engagement Office. (National University Science & Technology, n.d.)

1.2. Exit test for the general foundation programme (GFP):

At present there is no unified exit test for GFP at the national level. Each HEI designs their own assessment strategies upon elements like offered major course and students background. As foundation is mandatory pre-requisite for the undergraduate program, it is highly recommended to have unified exit test to ensure that all students are meeting required learning standards. (Anne Mathew & Batool, 2023). This study compares level of performance of the cohorts in placement test and in foundation course for past 4 years starting from academic year 2019 ensuring the quality of GFP offered at National University Science & Technology and recommend the course structure and assessment criteria followed at National University Science & Technology as a national level norm for then general foundation.

2. LITERATURE REVIEW:

A detailed review on “The use of item analysis for the improvement of objective Examinations” by Anna Siri, Michela Freddano was done. According to this, in the standardized and objective evaluation of student performances, the item analysis is a tool to assess the quality and quantity of the items and the test. The results emphasized that item analysis provides valuable information to the teachers to further structure modification and future test development and offers educational tools to assist them to ensure the quality of the programme.

A review on “Using reliability and item analysis to evaluate a teacher-developed test in educational measurement and evaluation by Kennedy Quaigrain & Ato Kwamina Arhin was done prior to this study. As per this study, item analysis is essential in improving items which will be used again in later tests. The study focused on item and test quality and explored the relationship between difficulty index (p-value) and discrimination index (DI) with distractor efficiency (DE) and thereby assessed the quality of the programme offered. (Quaigrain & Arhin, 2017)

A review on “Accuracy vs. Validity, Consistency vs. Reliability, and Fairness vs. Absence of Bias: A Call for Quality” by W. Steve Lang & Judy R. Wilkerson was done. Some part of this paper provides examples to demonstrate how to seek evidence of validity, reliability, and fairness of the programme offered at HEI’s with either statistical or non-statistical methodologies, disproving the assertion that statistical methods provide the only sources of evidence. (Lang & Wilkerson, 2008)

All three studies narrate the importance of item analysis as a great tool for educational assessments, evaluations, and conclusions. This really triggered idea of checking the quality of the foundation programme offered at National University Science & Technology, Oman, and there by proposing a national level course structure as there is no unified course delivery strategy and assessment pattern.

3. STATEMENT OF PROBLEM:

The study aims to prove the consistency, validity, and homogeneity of GFP offered at National University Science & Technology, Oman, thus recommend the course structure and the exit assessment criteria followed as a national level exit norm for GFP in Oman.

OBJECTIVES:

- To calculate the Standard deviation, Cronbach's alpha and coefficient variation of National University Science and Technology placement test.
- To calculate the Standard deviation, Cronbach's alpha and coefficient variation of assessments were used at various stages of GFP and at the exit test at National University Science and Technology.
- To check the homogeneity of the various assessments used at different levels of GFP at National University Science and Technology.
- To discuss the status of Cronbach's alpha and coefficient variation at entry, intermediate stage and exit stage of GFP.
- Summarize the findings of statistical analysis to prove the Consistency, Validity & Homogeneity of GFP offered at National University Science and Technology, Oman.

4. METHOD:

Each academic year, around 500 student results at various stages were considered. Initially standard deviation of each assessment was calculated. It is a measure of distribution of each value around the mean or average value of the assessment score. A standard deviation having a value near to zero or between 0 to 10 indicates that individual values are distributed very close to the mean, shows a consistency among data set. A high standard deviation (more than 20) indicates that the values are spready further away from the mean, relatively inconsistent data set.

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}}$$

Where n is the number of observations, x_i is each observation’s value and \bar{x} is the mean or average of the distribution (Standard Deviation: Interpretations and Calculations, n.d.). The standard deviation was used only at the initial stage to check the consistency of data. But later it was observed that it does not measure the exact distance of each observation from the central mean value.

Next stage was evaluating the co-efficient of variation and which is a statistical measure of the dispersion of data points in a data series around the mean. Coefficient of variance is a tool used to compare the stability, consistency, and uniformity of two sets of data. The lesser the value of coefficient of variation, the data distribution is better. For any distribution, the value of coefficient of variation is acceptable up to 20%. If the value is more than 20%, the distribution

of data is inconsistent and unstable. The data set with less value of coefficient of variation is more consistent than the data set with higher coefficient of variation.

$$\text{Coefficient of variation} = \frac{\text{Standard deviation}}{\text{sample mean}} \times 100 \%$$

Coefficient variation gives more authenticity on data consistency and uniformity while comparing it with standard deviation (Hayes, 2024).

As a continuation to this, the Cronbach Alpha for each assessment component for the general foundation programme offered was calculated. This is to identify the internal consistency or reliability of a set of data. It is measured in 0 to 1 scale. A high value indicates high reliability. A low value indicates relatively indicates the inconsistency among the distribution of data set for a particular assessment. A value 0.7 and above always indicates good reliability, whereas any value below 0.7 is acceptable but not ideal (Cronbach’s Alpha: Definition, Calculations & Example, n.d.). Spreadsheet software was used to calculate the Chronbach alpha at various stages.

Finally, the Chi Square test was performed to identify the homogeneity of the foundation assessment components, namely coursework, final exam and overall. An observed mean value from each assessment components were compared with an expected outcome to check is there any association between coursework, final exam, and overall results of each course (English, Mathematic & Computing skills). The mean value for each components were distributed in a table to calculate the expected outcome.

$$\text{Expected value} = \frac{\text{row total} \times \text{column total}}{\text{Overall total}}$$

From the table, p – value (probability) is calculated by using the excel software followed by null hypothesis and alternative hypothesis concepts. Null hypotheses formulate “no association” between any two components under consideration, whereas alternative hypothesis “association” between any two components under consideration. If p – value is greater than 0.05, the null hypothesis dominates, whereas if p– value is less than 0.05, alternative hypothesis will be considered (Test of Homogeneity | Concepts in Statistics, n.d.).

5. ANALYSIS, RESULTS & DISCUSSIONS:

Standard deviation and coefficient variation - National University Placement Test

Samples collected = 500

Table: 1.1

Academic Year	National University Placement Test		
	Mean	SD	CV (%)
2019	36.7	19.3	52.59
2020	47.5	22.00	46.32
2021	40.15	21.00	52.30
2023	36.35	20.50	56.49

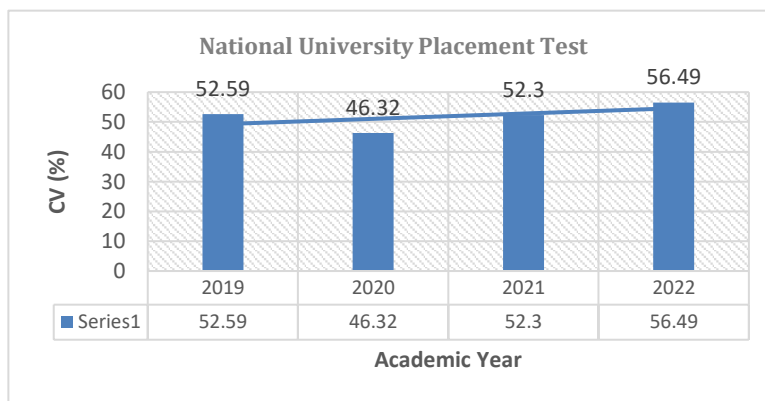


Chart: 1.1

Every academic year, the standard deviation for the placement test is 19 or above, which indicates that the scores are spready further away from the mean, relatively inconsistent data set. Moreover, the coefficient of variation for national university placement test generally on a higher side (above 20%), which clearly shows the in-consistency of cohort undergone the test. The trend line emphasis this point. This might be due to the high standards of the placement test and students are not trained enough to face the challenge.

Standard deviation and coefficient variation for General foundation components

Samples collected = 500

Table: 1.2

National University General Foundation Results (English)									
Academic Year	Coursework			Final exam			Overall		
	Mean	SD	CV (%)	Mean	SD	CV (%)	Mean	SD	CV (%)
2019	76	9.12	12	81	8.11	10.01	73	7.12	9.75
2020	77	8.79	11.42	79	7.12	9.01	79	9.79	12.39
2021	81	10.10	12.47	77	6.00	7.79	72	9.80	13.61
2022	79	7.89	9.99	77	9.34	12.13	71	6.39	9.00

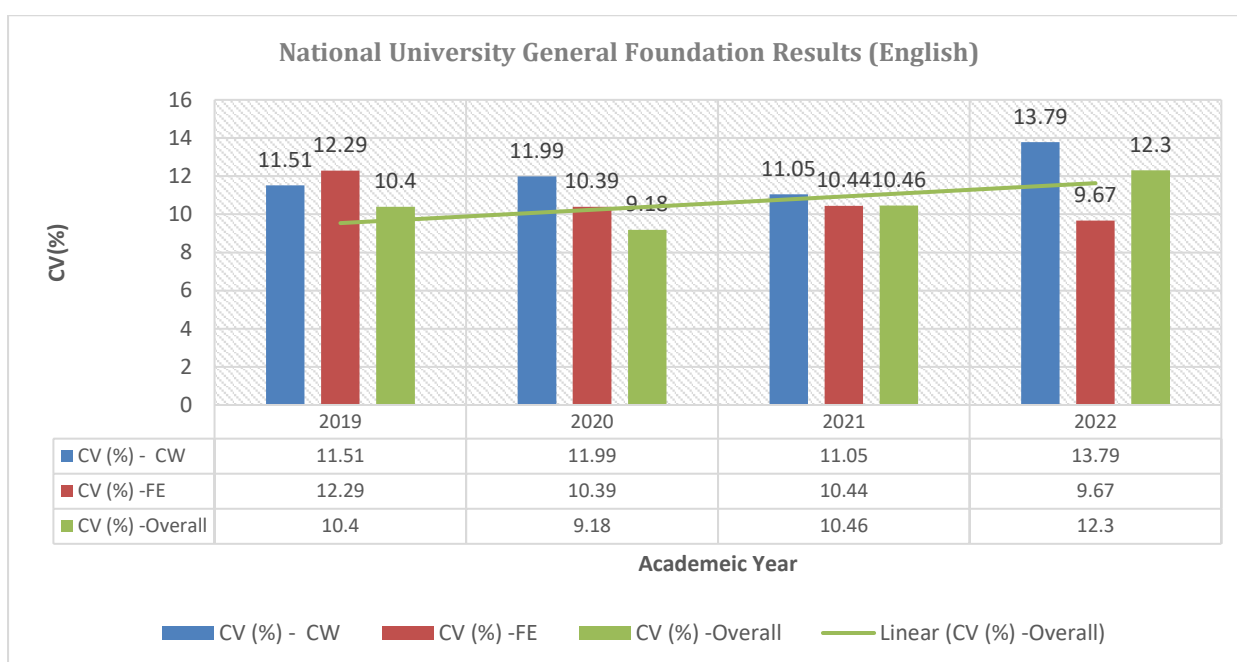


Chart: 1.2

Referring to **Table: 1.2**, the mean value of assessment marks in English falls in the range of 70 to 80 with an average standard deviation between 7 to 10. The coefficient of variation is in the range below 12%, which is in a healthy area.

National University General Foundation Results (Mathematics)									
Academic Year	Coursework			Final exam			Overall		
	Mean	SD	CV (%)	Mean	SD	CV (%)	Mean	SD	CV (%)
2019	79	7.32	9.27	77	8.11	10.53	76	9.13	12.01
2020	73	6.39	8.75	70	8.34	11.91	70	8.79	12.56
2021	72	8.58	11.92	79	8.10	10.25	73	9.67	13.25
2022	83	6.03	7.27	83	7.22	8.70	80	8.88	11.10

Table: 1.3

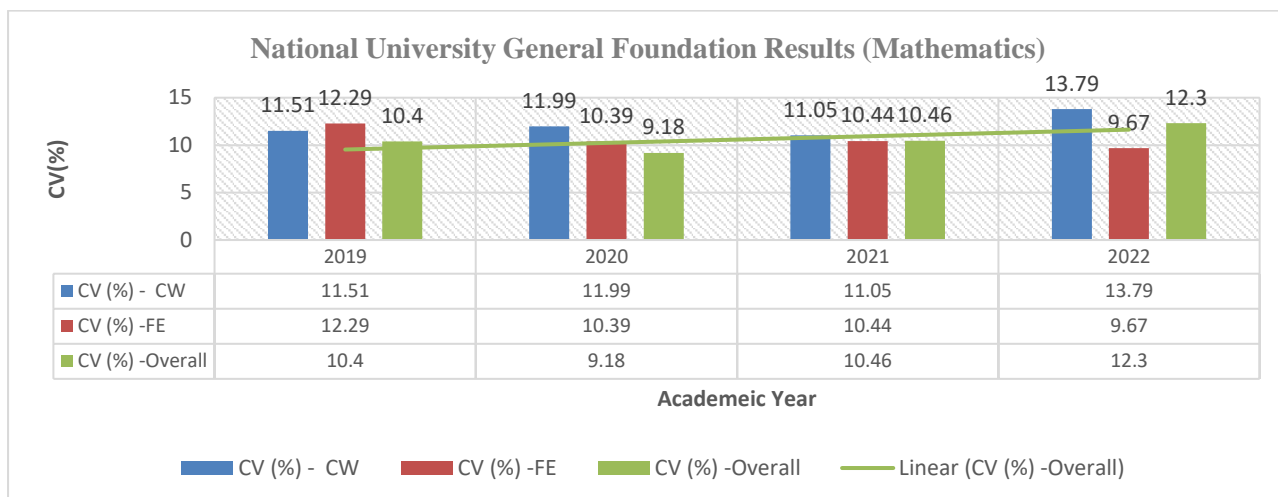


Chart: 1.3

Referring to **Table: 1.3**, the mean value of assessment marks in mathematics falls in the range of 70 to 80 with an average standard deviation between 6 to 8. The coefficient of variation is in the range below 12%, which is in a healthy area.

National University General Foundation Results (Computing Skills)									
Academic Year	Coursework			Final exam			Overall		
	Mean	SD	CV (%)	Mean	SD	CV (%)	Mean	SD	CV (%)
2019	81	9.32	11.51	84	10.32	12.29	80	8.32	10.40
2020	86	10.31	11.99	80	8.31	10.39	84	7.71	9.18
2021	84	9.28	11.05	79	8.25	10.44	82	8.58	10.46
2022	80	11.03	13.79	83	8.03	9.67	83	10.21	12.30

Table: 1.4

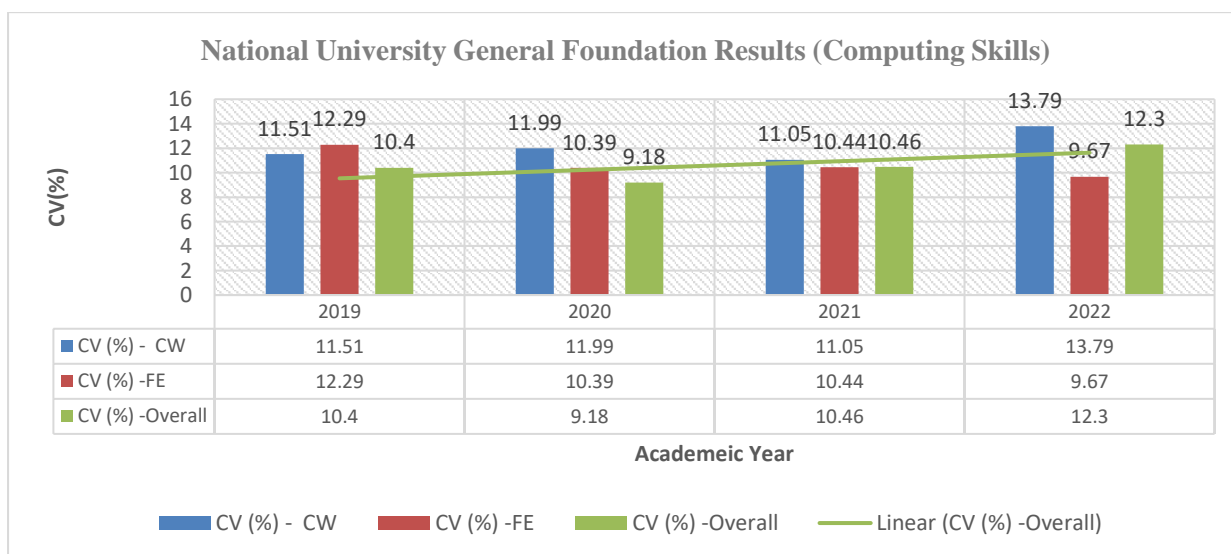


Chart: 1.4

Referring to **Table: 1.4**, the mean value of assessment marks in computing skills falls in the range of 79 to 84 with an average standard deviation between 7 to 11. The coefficient of variation is in the range below 13%, which is again a healthy area. Overall, the coefficient variation of National University Placement Test, when compared with GFP final

examination, course work and overall mark is too high, not in the acceptable range, which shows the in-consistency of National University Placement Test in every academic year. At the same time, coefficient variation values of final examination, course work and overall mark in each academic year are almost in similar and very much acceptable range (between 7 -14%), which shows the consistency among them. So, the conclusion is that there is a high-level consistency among the values of different components in general foundation programme offered at National University, Science & Technology, Oman.

The Cronbach Alpha for each assessment component is all academic year varies between 0.79 to 0.87, which indicates a high and good reliability of the general foundation programme offered at National University.

Homogeneity test

Academic year	Components	P- value		
		English	Mathematics	Computing skills
2019	CW, FE, overall	0.038	0.028	0.030
2020		0.042	0.032	0.043
2021		0.031	0.040	0.039
2022		0.037	0.021	0.042

Table: 1.5

The P-value for each subject in any academic year is less than the threshold value 0.05, which indicates there is a strong association between coursework and final examinations, hence the overall. This clearly proves the homogeneity of the general foundation programme offered at National University. However, the P-value found among various components of the national university placement test was found to be greater than 0.07, which shows inconsistency of the cohort at the time of entry to the university. But the same cohort showed a great improvement, consistency, and homogeneity as they completed the foundation programme at National University.

6. SCOPE OF THE RESEARCH:

As per Oman Academic Standards for General Foundation Programme, each higher education institutions are responsible for developing the methods of assessment by mapping the proposed general learning outcomes in these standards. *"The higher education institutions must demonstrate that the chosen assessment method is effective in determining whether the student has attained the required learning outcomes"* (OAAAQA - General Foundation Programme Accreditation, n.d.). Oman Academic Standards for General Foundation Programme clearly states that there is no standardized course materials & exit test available at present, hence this study is more relevant because it proves GFP offered at National University Science and Technology is valid, consistent, and homogeneous. Moreover, no other higher educational institutions in Oman have initiated this task currently. The outcome of this study will ensure the students learning atmosphere an interactive and effective, there by suggesting a national level general foundation course delivery strategy and assessment pattern for HEI's with effective curricular and extracurricular activities. This initiative will nourish the general foundation culture, that ultimately set a strong platform to transform students into global citizens with a quest for knowledge and its application, for the betterment of society, according to National University Science and Technology mission. This will be a strong steppingstone that will lead towards Oman Vision 2040. (Oman Vision 2040 Implementation Follow-up Unit, n.d.)

7. CONCLUSION:

The National Quality Plan 2006, (OAAAQA - General Foundation Programme Accreditation, n.d.) specifies the importance general foundation programme to prepare the students prior to the undergraduate studies which resulted in the development of Oman Academic Standards for General Foundation Programme in guiding the higher education institutions (HEI) with the structure of the general foundation programme to be followed. As there is no national level delivery strategy and assessment pattern in Oman for GFP, the research ensured the quality of the course structure and assessment criteria followed at National University Science & Technology and hence recommend it as a national level norm for the general foundation. The research focused on the comparative study between assessment results of an academic year cohort during an entry and exit test with the help of statistical terms such as standard deviation, coefficient of variation, Cronbach's alpha, and Chi Square test to support the claim. The data analysis and results ensured the quality of General Foundation Programme (GFP) offered at National University Science & Technology, Oman. Hence this study recommends a national level foundation bench marking process against the National University Science & Technology

foundation structure. This can be achieved through forming a focus group with the participation of representatives from various higher educational institutions. However, to follow up with the post foundation student's performance level to ensure further effectiveness of the foundation programme was found to be very difficult as students are segregated across various undergraduate programmes. This remains a limitation for this study and needs to find a mechanism to address this issue. The outcome of this study will ensure the students learning atmosphere an interactive and effective, there by suggesting a national level general foundation course delivery strategy and assessment pattern for HEI's with effective curricular and extracurricular activities. This initiative will nourish the general foundation culture, that ultimately set a strong platform to transform students into global citizens with a quest for knowledge and its application, for the betterment of society, according to National University Science and Technology mission. This will be a strong steppingstone that will lead towards Oman Vision 2040. (Oman Vision 2040 Implementation Follow-up Unit, n.d.)

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