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FACTORS AFFECTING STUDENTS' MATHEMATICS PERFORMANCE: A BASIS FOR MANAGEMENT DECISION IN OMAN'S HIGHER EDUCATION INDUSTRY

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Abstract

The purpose of the present study is investigating quantitative and qualitative factors influencing students' Mathematics performance at a particular College situated in Oman. It examined the correlation between attendance percentage, prior Mathematics learning, communication skills, mode of study, & gender, and students' Mathematics performance using relevant data from the College's database, year 2021 – 2022. Moreover, survey reports were also used to identify other factors. Analysis of the data used product-moment correlations, biserial correlation along with ANOVA, and thematic method. Gender and mode of study did not emerge as part of the equation; however, the findings indicated that English communication skills, class attendance, and prior Mathematics scores have significant effects on students' overall Mathematics performance. Furthermore, the thematic analysis found that although students are satisfied with the school climate, it seemed to suggest that students were burdened with the topics and were lacking proper motivation due to issues on teaching styles and lack of exercises linked to real-life applications.

Keywords: Mathematics Performance, Biserial Correlation, Oman, Thematic Analysis, Middle East

1. INTRODUCTION

Mathematics is a crucial part of people's daily lives with numerous applications in various fields such as architecture, art, computing, engineering, sports, and business (Hom & Gordon, 2021; Yadav, 2019). Having a proper understanding of Mathematics is an important characteristic that can help people to become more productive, reflective, and engaged members of society.

Mathematics literacy encompasses a variety of skills, such as fundamental Mathematical operations, the ability to reason with numbers, and spatial thinking (ICMI, 2023). However, according to European Commission, EACEA, and Eurydice (2022) many students find Mathematics challenging to understand and master. Similarly, research has shown that learning Mathematics is a common problem amongst pupils and students of all ages.

Ever since, the poor performance of students in Mathematics has been a global concern (Byrne, 2021). Furthermore, the study conducted by the Programme for International Student Assessment or PISA (2018) which included around 92 countries shows that 71 countries are having averages below 500 out of 1000 points signifying a considerable deterioration in Mathematics performance. Since only 92 nations were included, the

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results of other countries whenever included might even worsen the overall results, i.e., skewed to the right. This study by PISA has then provided evidence that the Mathematics performance target worldwide has not been fully attained yet.

In relation to the foregoing scenario, there have been many studies conducted to identify factors affecting Mathematics performance. Considerable number of studies focused on cognitive factors such as high school scores and standardized test results as the main predictor for Mathematics performance (Islam et al, 2017), which are commonly used for admission in many countries. However, some studies suggested that non-cognitive factors such as school resources, school climate, and number of enrollments (Kusdinar and Kismiantini, 2018), interest and study habits (Landicho, 2021) may also affect Mathematics achievement.

In recent times, several studies have also shown various factors influencing Mathematics performance although some of these factors overlapped with other studies' findings. The study by Demir et al (2009) showed that school climate, student background, learning strategies, and self-related cognitions are amongst these factors. Similarly, the study by Peteros et al (2020) showed that Mathematics self-concept, which is students' rating of their ability, skills, enjoyment, and interest in Mathematics is a significant factor.

This is similar to the findings of Endagamage et al (2017) who asserted that attitudes, confidence, liking of the subject, motivation, and relevance of the field are important factors. Furthermore, some other interesting studies had also revealed some unique and common factors. Sardauna and Yusuf (2018), for instance, showed that the main factors related to Mathematics achievement are teachers' competence, teaching method, inadequate teaching materials, socio-economic status, and parental education. Some of these factors are supported by Makondo and Makondo (2020) who asserted that teaching method, teachers' lack of experience and instability, inadequate teaching materials, and parents, students, and teachers' negative attitudes are the main factors.

This was further supported by the study conducted by Ayebale et al (2020) revealing that teachers and students' attitudes, teaching method, parents' efforts, classroom environment, and learners' prior Mathematical knowledge are the main important factors. In addition to these, the study by Kiarsi and Ebrahimi (2021) also showed that teaching method, learners' prior Mathematical knowledge, teachers' negative attitudes, Maths anxiety, lack of practice, parents' support, classroom environment, family background, and social factors affect Mathematics performance.

Similarly, other studies revealed related and/or relevant factors such as self-engagement in Mathematics, Maths anxiety, and use of technology as asserted by Brezavscek et al (2020), Mathematics attitude stated by Tamayo (2021), strictness amongst teachers, lack of exercise and lack of attention by students mentioned by Jameel and Ali (2016) and those asserted by Kumah and Wonu (2022) saying that Mathematics performance is affected by college-related, parent-related, and student-related factors. In conjunction with the foregoing elaborations, other studies confirmed that the performance of students in Mathematics is affected by the teaching & learning methods and students' cultural backgrounds (Acharya et al, 2021).

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These methods encompass student-centered method, teacher-centered method, and the kinds of assignments and other tasks or homework afforded to students. Learning methods can include but not limited to group work (brainstorming sessions) to solve problems, individual activities given by lecturers or exercises followed by students using a textbook or worksheets, etc. (Sitko, 2013). Sitko also added that the rapport between students and teachers, the way students are punished, and the way homework and assignments are made and distributed might influence the achievement of these students in Mathematics; however, learning environment may also affect students in various schools in terms of concentrations and focus.

In addition to the studies above, one of the targets worldwide in terms of performance is the Middle East region which is one of the most strategic parts of the global economy. In recent years, it has invested largely and redirected its attention to the construction of state-of-the-art facilities including digitalization, economic growth, and education (Habibi and Zabardast, 2020). The region has made considerable progress due to oil revenues which have helped its GDP and created more opportunities for development including education (Institution of Civil Engineers, 2022). Several countries in the Middle East, specifically members of the Gulf Cooperation Council (GCC) countries offer free education and have made strides in improving literacy and enrollment rates. Despite these efforts, the educational system in the region still falls short of international standards, particularly in Mathematics education (Badran et al, 2019).

The above-mentioned situation in the Middle East is particularly evident in the Sultanate of Oman, hereinafter referred to as Oman. It is one of the richest in the Middle East according to Mappr (2022) and is part of GCC which also includes Saudi Arabia, Qatar, Kuwait, Bahrain, and UAE. Oman's ranking as of 2022 is 72nd out of 76 countries (Speiser, 2022). This country's performance in Mathematics education is also revealed in its achievement results in the international test, the so- called TIMSS or Trends in Mathematics and Science Study (TIMSS, 2019).

A few studies investigating factors influencing Mathematics performance have been also conducted in Oman. Islam et al (2017), for example, showed that the Mathematics performance in Sultan Qaboos University (SQU) is unsatisfactory and that the main reasons were cohort of students, gender (female students performed better than male students), and Mathematics prior learning. In addition, teacher quality (Ambusaidi and Yang, 2019), and nature of school (Rahbi, 2020) were mentioned as main determinants in terms of Mathematics achievement. In addition, Rahbi said that private-school students performed better than public-school students and for this reason, many parents opted for the former to educate their children.

Similarly, 2 other studies in Oman were also conducted. Al Hosni & Ambusaidi (2020) revealed that supportive classroom environment, connectedness between students and teachers, and intellectual quality are the main factors affecting the same. Furthermore, Devesh (2015) asserted that external observer's involvement is needed to improve mathematics performance in HEIs, and teachers and management should also gather student feedback from students and use it to improve performance. Devesh suggested working with a competent community of learners to design/redesign the curriculum to

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meet international standards and motivate students by connecting topics to the real world and their inputs should be integrated into teaching practices and styles within the classroom. Her article also stressed that creating a challenging but comfortable learning environment with interactive sessions and support for students' growth and interests is crucial. In summary, Devesh outlined the responsibilities of students and teachers to have a positive Mathematics performance. For students, she says that there should be active participation, proper use of tools and computational strategies, critical thinking, teamwork, and effective communication, and for teachers, they should develop effective teaching approach and instruction styles, proper assessments, curriculum design and evaluation, proper classroom environment, positive attitudes, and be able to use flipped classroom.

Considering all the studies related to Mathematics performance, it seems to suggest that the main factor is teacher-related (strictness, teaching method and quality/competence). This is then followed by student background and/or family/parental background. Teachers' and students' attitudes towards Mathematics, school climate and/or classroom conditions then follow. These are then followed by self-related factors (students' self-concept and self-engagement). Inadequate teaching materials emerged as the next and then followed by prior Mathematics learning.

Other common factors asserted are related to students' interest/ attention, Maths anxiety, motivation (teachers, students, and parent), and students' lack of practice, and social as well as socio-economic features. Unique factors highlighted are attribution, learning strategies, number of enrollees, pressure, study habits, connectedness, and use of technology. Although significant amount of research asserted that there is no gender difference (Peteros et al, 2020; Sardauna and Yusuf, 2018), other research works, e.g. (Islam et al, 2017) confirmed that factors affecting the same are gender related.

As can be observed, the factors are a combination of cognitive and environmental aspects which relate to social learning theory introduced by Albert Bandura. Bandura's theory asserts that learning transpires through "observation, imitation, and modeling, and is influenced by factors such as attention, motivation, attitudes, and emotions" (Kendra, 2022). One of the highlights in Bandura's theory is the self-efficacy theory which refers to individual's beliefs in their ability to accomplish a task or achieve a desired goal (Hayat et al, 2020; APA, 2022). Accordingly, students who attend Mathematics classes regularly may develop a strong sense of self-efficacy which may lead to positive Mathematics performance.

Other factors pertinent to Mathematics performance related to Bandura's theory are mostly covered by various studies; however, investigating the correlation between attendance percentage and Mathematics achievement has not been mentioned in any of the studies delved into. There is one conducted by (Yilmas, 2022), however, his study focused on distance education and not face-to-face. This is one of the gaps to be filled in this study. This is an important aspect to investigate as positive attendance percentage in Mathematics can enhance students' perceptions of the importance of the subject which may result in increased effort and much better outcome in Mathematics which also relates to the expectancy-value theory asserting that students' effort & motivation are affected by their expectations of success and the value they assign on the subject (Mathew et al,

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2022) and corresponds to the cognitive load theory (Becton, 2022), which states that the amount of mental effort required to process new information affects learning suggesting that regular attendance in Mathematics may reduce cognitive load by providing students with constant exposure to the given materials which may result in better performance. Positive attendance percentage in Mathematics can then enhance students' perceptions of the importance of the subject which may result in increased effort and much better outcome in Mathematics.

Furthermore, the cognitive development and socio-economic status of students can impact their ability to learn and perform in Mathematics. This relates to socio-economic status theory stating that students' socio-economic background can affect their educational access to opportunities and resources. This also relates to the theory of cognitive development which states that students' cognitive development influences their ability to learn new materials, implying that students with a strong prior Mathematics background possessing previous experience of dealing with mathematical problems may be better equipped in terms of dealing Mathematics leading to better performance.

Prior Mathematics learning background is then an important aspect to investigate and since this data is available in the same College's database, this will also be included in this study focusing on the Foundation Mathematics which are taken by students prior to level 1 as part of Ministry of Higher Education's requirement. This is important to look at as there has been no studies conducted in Oman related to this. There is a similar study conducted as mentioned in the preceding section by Islam et al (2017); however, their study uses high school scores, not Foundation scores.

In the context of constructivist theory (Brau, 2020) and communication accommodation theory (Elahmi, 2020) effective communication, including adjusting communication to students' needs and facilitating discussions can enhance learning. This suggests that effective communication can facilitate the process by allowing students to connect their prior knowledge to the new material and engage in discussions with their peers and teachers which leads to positive performance.

The study conducted by Devesh as mentioned in the preceding section asserted that effective communication is important to gain positive performance in Mathematics; however, there is no mention how to measure this variable. This is also one of the gaps to be addressed in this study by looking at the correlation between language and Mathematics scores. Lastly, social identity theory suggests that characteristics like age, gender, nationality, and mode of study can influence students' mathematics performance, while cultural-historical activity theory proposes that cultural and historical contexts also affect learning and performance.

These factors are then important to investigate; however, since most of the students under study have negligible age difference and expatriate students are only around 2% to 5% of the population, these factors will not be included in the study. Gender will be part of this study since there are contradicting findings in terms of gender as highlighted in the literature above. Mode of study will also be included since there is a difference in terms of delivery hours between part-time and full-time students which relate to cognitive load

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theory and expectancy-value theory as discussed above. In light of the foregoing elaborations, this study delves into factors affecting Mathematics performance by looking at gender, mode of study, Mathematics prior learning, attendance percentage, and effective communication. Moreover, this study provides a thematic analysis using the student feedback report to gather additional factors influencing the students' performance. The purpose of the study is not contrasting these factors but to examine them in terms of its influence on Mathematics achievement. Investigating all these factors provides a better comprehension on educational concerns towards improving students' achievement in Oman. Moreover, studying these factors is crucial because Mathematics is an essential subject for success in various professional and academic fields. This can help policymakers, educators, parents, and other stakeholders provide support to students and improve their performance. Efforts can then be made to create a more effective and supportive educational environment for all students.

2. MATERIALS AND METHODS

To investigate the influence of various level of factors on Mathematics performance, the present study applied both product-moment (bivariate and multiple) and biserial correlational methods. It should be noted that the biserial correlation results were verified using ANOVA. To identify other factors, survey reports were also analyzed using a thematic method using coding in a thematic matrix.

1. ANOVA & Correlations (Point-Biserial and Product-Moment)

The data for this study was obtained from the College Database which is under its Registry Department. Different levels of samples were extracted to produce the desired results. To show the performance trends, at most 4 year-data was collected which has around 8 cohorts, which in particular included almost 3000 entries. Amongst these students, only 742 were considered for bivariate correlations' independent data (attendance, mode of study, and gender). This is mainly because only 2 cohorts were included, two-year data (Sep 2021 – Jan 2022 & Feb 2022- June 2022) where all classes were conducted face-to-face after the pandemic (COVID-19) and where the average results of the students have shown the lowest dip ever recorded as indicated in table 1. In addition, re-takers and normal students were only the ones included in the attendance analysis as referral students (those who failed during the previous semesters) do not attend classes due to non-assignment of class groups; they just join other students during their respective assessments. For multiple correlations, however, to identify the correlation between Mathematics prior learning and Mathematics performance, all students in level 1 & 2 (normal/retake/referral) who took Foundation Mathematics were included due to data availability. Furthermore, to identify the correlation between communication skills and Mathematics performance, only 761 (Level 1 & 2) were included due to module combinations, i.e., some students have not yet taken the required modules. Refer to the Appendix section for more details on the data treatment. The final Mathematics grades of these students along with their grades in English modules, cohorts, gender, Foundation Mathematics scores, and other additional data were obtained from the same database under report and curriculum sections. Grades were

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recorded on a 100-point scale; from 0 to 100, where 0-39.99 = Fail (G, F-, F, and E); 40-49.99 = Satisfactory (D-, D, and D+); 50-59.99 = Good (C-, C, and C+); 60-69.99 = Very Good (B-, B, and B+); 70-79.99 = Excellent (A- and A); and 80-100 = Outstanding (A+). Data was obtained from students' reports as PDF format and then imported to MS Excel and then to SPSS. The study considered the Mathematics performance (Final Grades in L1 & L2) of students as an outcome, the dependent variable; while attendance percentage, Foundation Mathematics score (prior to level 1 and level 2 Mathematics), communication skills, mode of study, and gender were considered as the independent variables. Both inferential and descriptive statistics were utilized to conduct the analysis. For all key variables, descriptive statistics were calculated using advanced MS Excel functions. The inferential statistics part involved correlation coefficient & determination and Analysis of Variance (ANOVA) using MS Excel and SPSS 26. For correlation analysis, the researcher employed two types: 1) Product-Moment Correlation Coefficients for bivariate and multiple quantitative variables, in particular the attendance percentage, Foundation Mathematics score, and the communication skills and 2) Bi-serial Correlation Coefficients for categorical variables, which are dichotomous in nature, i.e., gender and mode of study.

Considering the above, it should be noted that Pearson product-moment correlation measures the strength of linear relationship between two (2) variables which falls under interval or ratio level of data meaning quantitative data only and is denoted by '*r*' (Laerd, 2022). It can be any value from -1 to 1 where 0 indicates that there is no association between 2 variables. The higher the value of r, the higher the correlation. A positive correlation indicates that as one variable increases, the other variable also tends to increase and as one decreases, the other also tends to decrease. A negative correlation indicates that as one increases, the other decreases and vice versa. Since this coefficient is applicable for the first 3 factors considered in this study, i.e., attendance percentage, communication skills, and Foundation Mathematics scores, it is therefore used herein with proper analysis. It should be noted that the formula to calculate the correlation coefficient without a software is as below.

$$r = \frac{\Sigma\,(xy) - \frac{\Sigma x \Sigma y}{N}}{\sqrt{\left(\Sigma x^2 - \frac{(\Sigma x)^2}{N}\right) * \left(\Sigma y^2 - \frac{(\Sigma y)^2}{N}\right)}} \quad \text{Eq. 1}$$

In the case of bi-serial correlation coefficient, it is important to note that this is only intended for measuring the correlation between two (2) variables where one is continuous variable (quantitative) and the other one is a categorical variable (Heidel, 2022). In this research, it is then used to determine the relationship between Mathematics performance (grades achieved) which is continuous data matched with the categorical ones: gender and mode of study. To calculate the value of r_{pb} (correlation coefficient of point biserial), the following formula applies:

$$r_{pb} = \frac{M_1 - M_0}{s_n}\sqrt{\frac{n_1 n_0}{n^2}} \quad \text{Eq. 2}$$

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Where M_1 = Average value on the continuous variable x for all data points in the first group and M_0 = Average value on the continuous variable x for all data points in the second group. Moreover, S_n = Standard deviation for the continuous data; n_1 = number of data points in the first group, n_0 = number of data points in the second group, and n^2 = the square of the total sample size. The first group for y will be assigned 1, and the second group for y will be assigned 0. In gender, for instance, male = 1, and female = 0, which is also used in this study. It should be noted that the analysis in this study was not done manually using the formula (Eq. 2) but using SPSS.

2. Student Feedback Report (Thematic Analysis)

Aside from the multiple sets of data above, a separate set of qualitative data was also gathered to identify other factors, this is the comment section of the semester-wise survey results emanating from the Online Student Feedback Form (SFF) which is conducted by the Registry Department every semester to collect feedback from students. The qualitative data is organized using a thematic method where various feedbacks from students are categorized into themes and sub-themes to provide meanings to comments provided by students leading to adequate interpretations of their feedbacks.

3. RESULTS

Table 1 shows the average scores and pass rates for 4 years, 2018 up until 2022. The Mean – L1 column shows the average of grade points of Level 1 Mathematics students while the Mean – L2 column lists the averages of grade points of Module 1 (Level 2) and Module 2 (Level 2) Mathematics respectively. The pass rate column shows the pass rates of level 1, Module 1 (Level 2), and Module 2 (Level 2) Mathematics respectively. This is mainly because there is only 1 Mathematics module for level 1 which is taken by all students regardless of their pathways, level 2 has 2 Mathematics modules (1 is taken by Information Technology students and 1 is taken by Business Management students). The distribution of scores and pass rates in Level 1 and 2 Mathematics as depicted in table 1 indicated a considerable difference during the pandemic where the classes and assessments are online and after the pandemic where the classes and assessments were delivered face-to-face.

The results after the pandemic showed that the averages in level 1 and level 2 modules lingered around 39 to 43 only (Refer to fig. 1), which means that most of the students were just meeting the threshold standards. This is way much lower compared to the results during the pandemic, lingering around 46 to 59. In addition, the performance before the pandemic is also not very high, however, it is better compared to the post-pandemic results, especially for level 1 Mathematics. Overall, the average results and pass rates are very low after the pandemic, which consists of 2 cohorts (Sep 2021- Jan 2022 & Feb 2022 – Jun 2022). For this very reason, the researcher of this study set more focus on these cohorts where all strategies are delivered face-to-face. Furthermore, considering the actual sample of 742, male accounted for 29.38% and female accounted for 70.62% as shown in tables 2 and 3. In addition, it can also be seen in the same table that most of the students in the study are coming from the full-time mode of study, for example only 27.09% (201/742) are part-timers. Tables 2 & 3 indicate that there were no

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significant correlations observed when mode of study and gender were correlated with Mathematics performance. However, the results (in descending order) showed that effective communication skills, class attendance, and Mathematics prior learning had positive significant effects on Mathematics performance. In addition, fig. 2 shows that students were burdened with the topics and were lacking proper motivation due to issues on teaching styles and lack of exercises linked to real-life applications while indicating that they were satisfied with the school climate.

Table 1: Results & Pass Rates of L1 & L2 Mathematics

Semester	Mean-L1	Mean-L2	Pass Rate (%)	Mode
Sep 2018 - Jan 2019	61	43 & 51	86, 68, 70	F-2-F
Feb 2019 - Jun 2019	50	44 & 41	73, 54, 56	F-2-F
Sep 2019 - Jan 2020	41	46 & 49	60, 64, 63	F-2-F
Feb 2020 - Jun 2020	53	54 & 39	84, 76, 53	Online
Sep 2020 - Jan 2021	62	56 & 50	96, 79, 67	Online
Feb 2021 - Jun 2021	61	53 & 49	94, 66, 69	Online
Sep 2021 - Jan 2022	39	45 & 47	47, 53, 59	F-2-F
Feb 2022 - Jun 2022	39	38 & 39	56, 42, 49	F-2-F

**F-2-F = Face-to-Face; **Online (Classes during COVID era)*

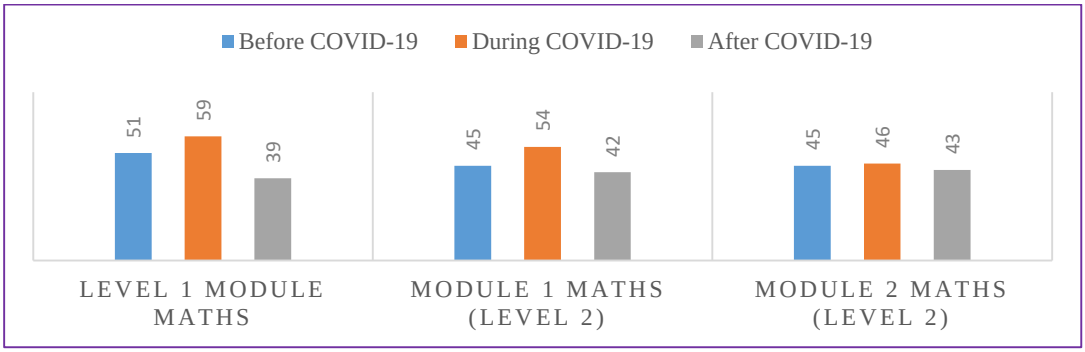

Figure 1: Average Grade Points – L1 & L2 Mathematics

Table 2: Gender, Mode of Study, Attendance, and Mathematics Background vs. Mathematics Performance – L1

Attendance, Mode of Study, Gender, and Mathematics Prior Learning vs. Mathematics Performance							Language/Effective Communication Skills (English Scores) vs. Mathematics Performance			
Cohort	**Measures**	**Attendance (%)**	**Mode of Study**	**Gender**	**Prior Maths Scores (Basic Maths)**	**Prior Maths Scores (Applied Maths)**	**Level 1 Mathematics Performance**	**English 1**	**English 2**	**Level 1 Mathematics Performance**
Feb 22 – Jun 22	No. Mean ± SD r, p-value	164 78±15 0.611, 0.00	FT=137, PT=27 - -0.049, 0.537	M=42, F=122 - 0.210, 0.007	440 71±20 0.488, 0.01	461 67±20 0.438, 0.01	Mean ± SD = 47±21	170 49 0.721, 0.00	104 53 0.664, 0.00	Math 1 (Mean = 42) Math 2 (Mean = 38)
Sep 21 – Jan 22	No. Mean ± SD r, p-value	180 79±15 0.472, 0.00	FT=139, PT=41 - -0.054, 0.472	M=48, F=132 - -0.089, 0.233			Mean ± SD = 38±20	67 52 0.703, 0.00	87 58 0.694, 0.00	Math 1 (Mean = 40) Math 2 (Mean = 43)

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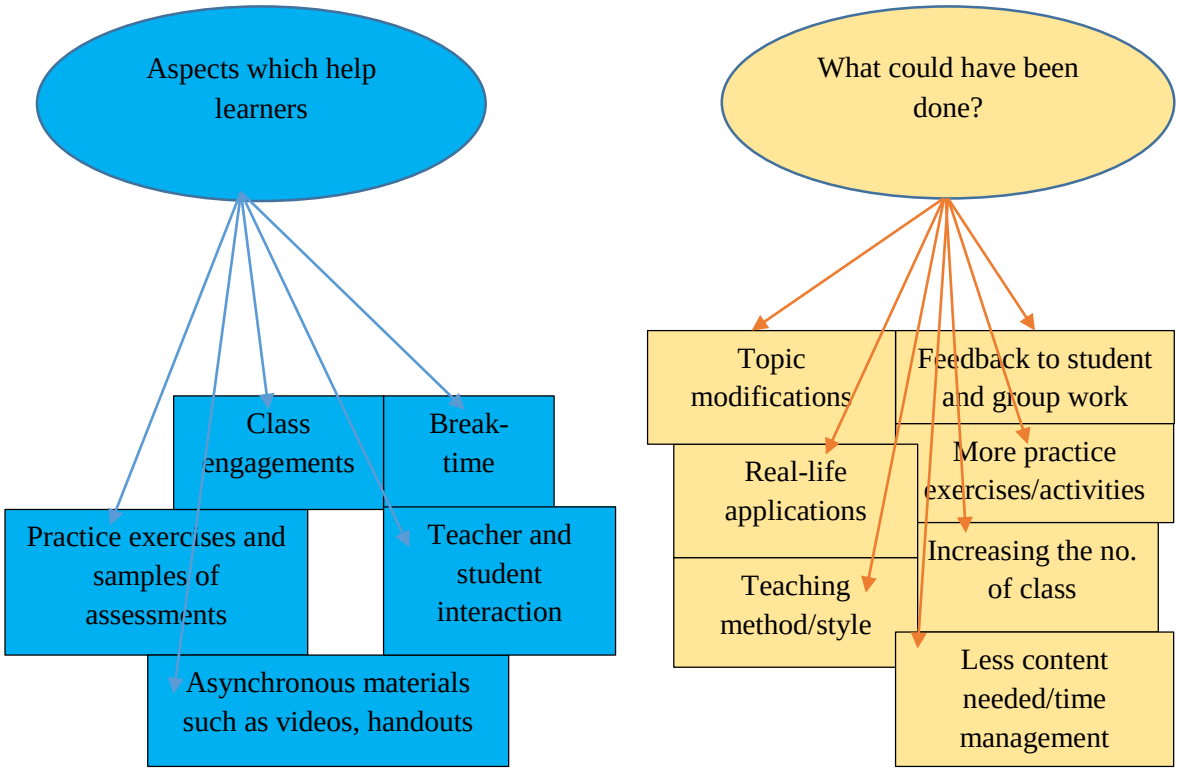
Table 3: Gender, Mode of Study, Attendance, and Mathematics Prior Learning vs. Mathematics Background – L2

Attendance, Mode of Study, Gender, and Mathematics Prior Learning vs. Mathematics Performance							Language/Effective Communication Skills (English Scores) vs. Mathematics Performance			
Cohort	**Measures**	**Attendance (%)**	**Mode of Study**	**Gender**	**Prior Maths Scores (Basic Maths)**	**Prior Maths Scores (Applied Maths)**	**Level 2 Mathematics Performance**	**English 3**	**English 4**	**Level 2 Mathematics Performance**
Feb 22 – Jun 22	No. Mean ± SD r, p-value	146 78±15 0.599, 0.00	FT=104, PT=42 - -0.047, 0.572	M=46, F=100 - 0.0.036, 0.665	432 63±20 0.513, 0.01	423 66±23 0.360, 0.01	Mean ± SD = 45±24	62 41 0.549, 0.00	56 41 0.587, 0.00	Math 1 (Mean = 32) Math 2 (Mean = 29)
Sep 21 – Jan 22	No. Mean ± SD r, p-value	252 83 ±11 0.318, 0.00	FT=161, PT=91 - -0.058, 0.012	M=82, F=170 - 0.005, 0.941			Mean ± SD = 47±21	34 47 0.265, 0.00	181 52 0.555, 0.00	Math 1 (Mean = 45) Math 2 (Mean = 46)

***p-value used: < 0.01



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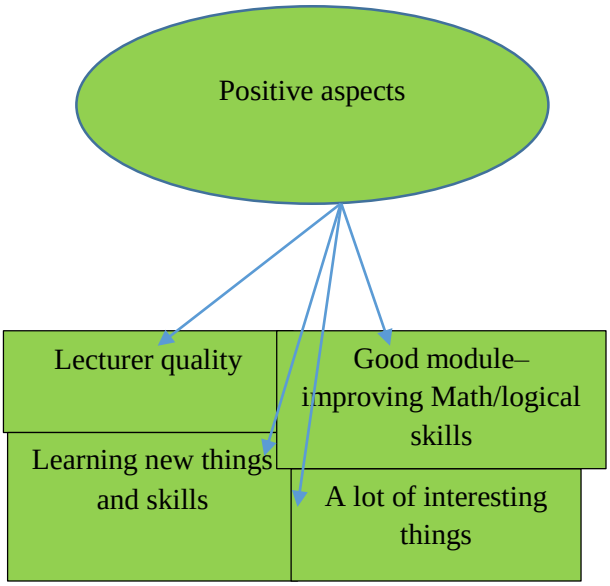

Figure 2: Thematic Analysis Results (Student Feedback Report)

4. ETHICAL CONSIDERATIONS & DISCUSSIONS

The present study is primarily concerned with the effect of mode of study, gender, communication skills, class attendance, and prior Mathematics learning on Mathematics performance in Oman. To investigate these factors and/or variables, the study utilized data from the College database, 2021 – 2022. Ethical considerations were considered to set the guiding principles on the research design and practices. The researchers ensured that specific code of conduct was adhered to when the collection of data was performed to protect the rights of others, enhance validity, and maintain academic integrity.

Since data was collected from the College database where the researcher was given access as confirmed by the Head of Registry through e-mail confirmation along with VPN Access and credentials, the author consequently abided by the ethical considerations stipulated in the Philippine Republic Act 10173 – Data Privacy Act of 2012 (DPA) 2012 and the data protection law issued in Oman, the Royal Decree 6/2022, which is the Personal Data Protection Law (PDPL) issued on February 2022. In this regard, no student data is displayed in this report, except for their overall Mathematics performance taken as a sample, their averages, pass rates, and standard deviations. Furthermore, qualitative comments obtained from the survey results with the green light from the Head of Faculty were also analyzed by focusing only on the comments and without any students being mentioned. In its entirety, this study then confirms that pertinent data was accessed with the knowledge and go signal of the concerned database officiating in-charge. Moreover, the authors also confirm that personally identifiable data were anonymized in such a way that it cannot be linked to other data by someone else and that all stakeholders are not jeopardized physically, socially, psychologically, and in terms of other types of harm. Refer to all the tables and figures in this regard for further information.

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Investigating the correlation of attendance percentage variable of both level 1 and 2 students and their Mathematics achievement revealed that students' attendance positively affects their academic achievement. As seen in tables 2 and 3, all correlations are positive indicating that in general students' attendance affected the overall performance in the same direction, meaning the lesser the attendance percentage, the lower the Mathematics score. In terms of correlation in level 1, r1=0.611 (d=37.33%) and r2=0.472 (d=22.27%) indicating that the attendance percentage in this level is affecting the Mathematics performance by 22% to 37%. Similarly, in terms of correlation in level 2, r1=0.318 (d=10.11%) and r2=0.559 (d=31.25%) indicating that the attendance percentage in this level is affecting the Mathematics performance by 10% to 31%. This result is consistent with one study, i.e. (Devesh, 2015) saying that students should have active participation in the class although not measured statistically. Similarly, this finding is consistent with Yilmas (2022) saying that class attendance has a positive correlation with exam scores in Mathematics, implying that students should attend classes to the maximum extent to gain proper understanding of the Mathematical concepts.

On contrary to Islam et al (2017), the findings of the study as shown in tables 2 and 3 indicated the lack of relationship between gender and students' Mathematics achievement. However, this finding is consistent with (Peteros et al, 2020; Sardauna and Yusuf, 2018), saying that Mathematics performance is not gender related. This signifies that academic achievement in this region does not rely on the students' characteristic, which is gender. Similarly, this study also revealed that mode of study is not a determinant in terms of academic achievement. This signifies that students, whether part-time or not performed similarly in Mathematics. This is an important point to reflect upon as the college's part time students where this study is conducted are having only 3 hours per week, while full-timers have 4 hours. The result may then suggest that part-time students are able to adapt to the requirements and are not disadvantaged to a significant extent. This might be because most part-time students are already working and more matured allowing them to cope up with the requirements, considering their exposure to the practicalities at work.

Tables 2 & 3 also show the multiple correlations between the Foundations Mathematics modules' scores obtained by students prior to taking College courses such as Business Management, IT, and English Language and their Mathematics performance. The sampled data indicated that L1 and L2 College Mathematics averages were around 38 (+20) and 43 (+21) out of 100 respectively, see fig. 1. On the other hand, the Foundation Mathematics scores range around 63 to 71 out of 100 (+20-23) signifying that they have performed better in their previous years.

It should be noted that students need to take 2 Mathematics in the Foundation Programme, Basic Mathematics (BM) and Applied Mathematics (AM), before they can embark on any courses in the Undergraduate Programme in Oman. So, in most colleges/ univerisities in Oman, they have to take BM & AM prior to Level 1 & 2 Mathematics. Since these datasets are available in the College database, Foundation scores (Prior Maths Learning) were then correlated with L1 & L2 Mathematics and it revealed that both BM and AM are positively correlated with Level 1 and 2 Mathematics, indicating that those

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who performed better in Foundation also performed well in the Undergraduate Mathematics courses and those who struggled with Foundation Mathematics tend to struggle also in their higher-level Mathematics. The results did not show perfect correlations as expected; however, it shows that in level 1 as depicted in table 2, the correlations range from 0.438 to 0.488, implying that Foundation scores affected Level 1 Mathematics by 19% to 24%. For level 2 as depicted in table 3, the correlations range from 0.360 to 0.513, suggesting that Foundation scores affected level 2 Mathematics by 13% to 31%. This finding, justifying that Mathematics background or prior learning affects Mathematics performance is consistent with many studies, e.g. Ayebale et al (2020); Kiarsi and Ebrahimi (2021). This further suggests that Mathematics background has a great impact on the existing Mathematics performance. Parents, educators, students, and the management should then work hand in hand to ensure that proper and strong background in Mathematics is upheld before enrolling in any undergraduate programmes. This finding is also supported by many theories mentioned in the foregoing discussions such as the theory of cognitive development, cognitive load theory, and self-efficacy.

Furthermore, this study has investigated the effect of communication skills on Mathematics achievement. Level 1 Mathematics results were correlated with level 1 English scores and similarly, level 2 Mathematics scores were correlated with level 2 English scores as shown in tables 2 and 3. The study revealed that in both levels, the effect is positively significant, implying that those students with effective communication skills were more advantaged in terms of understanding Mathematical concepts as compared to those students with poor communication skills. Level 1 proved to have the highest correlations, ranging from 0.664 to 0.721, and hence giving an implication that language affects the academic achievement in level 1 by around 44% to 52%. Level 2 correlations range from 0.265 to 0.587, indicating that language affects the academic achievement in level 2 by around 7% to 34%. This finding is consistent with what was mentioned by Devesh (2015) stating that effective communication is a significant determinant to obtain positive results in Mathematics.

5. CONCLUSIONS & RECOMMENDATIONS

The study findings revealed a considerably dreary situation in terms of Mathematics performance at the college under study specifically after the COVID era. Overall, level 1 and 2 Mathematics have only around 51% pass rate on average within the covered period and having very low average results, lingering around 39% and 43% respectively. These results indicate that many students enter College Level 1 Mathematics with minimal preparations and hence unable to cope up with the topics in the said level which has a domino effect in their Level 2 Mathematics. This was evident when their Foundation scores and English communication skills were correlated with their performances in Level 1 and 2 Mathematics indicating that students struggled due to poor Mathematics background and inadequate communication skills. The correlations, however, revealed that there were other factors affecting their Mathematics performances. In this regard, other factors were considered such as the class attendance, mode of study, gender, and communication skills. Although gender and mode of study did not emerge as part of the

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equation implying that in general, students perform similarly regardless of gender (male or female) and mode of study (full-time and part-time), it seems to suggest that during the new normal, many students were not serious in attending classes and thus affecting the overall performance. This could be an after effect of the pandemic where students experienced burnouts. In particular, the data suggests that at most 31% can be attributed to Foundation Mathematics background, at most 37% might be caused by the class attendance, and at most 52% can be due to communication issues which is the highest of all the variables considered.

Furthermore, the thematic analysis found that although students are satisfied with the school climate, it seems to suggest that students are burdened with the topics and are lacking proper motivation due to issues on teaching styles and lack of exercises linked to real-life applications. Although, this study has justified that communication skills and learning background as well as regular attendance significantly affect the Mathematics performance, the critical review of literature has argued that there are multi-faceted factors affecting the same depending on various conditions and settings. Hence, a thorough study can be conducted to verify the results of this study and/or consider other factors depending on the contexts of the students being covered.

In relation to the above findings, the higher education institutions in Oman are advised to review the contents of their Foundation Programme and ensure that students are equipped with necessary communication skills and fundamental Mathematical skills before entering undergraduate level. Level 1 and Level 2 Mathematics lecturers are also advised to align their materials and improve their teaching styles and intensify practice exercises and activities coupled with significant real-life applications for students to be highly motivated and to easily understand the concepts. Lecturers should engage their students more in the class and introduce activities that catch students' attention, allow them to participate to the maximum, and improve their abilities. Colleges may also intensify its entry requirements to screen students before enrollments and enforce IELTS requirements prior to registration. Furthermore, class attendance should be properly monitored, and students' personal issues should be adequately looked into to ensure that they do not go astray and be able to maintain their focus to progress successfully.

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APPENDICES

A. Samples of Thematic Analyses Using Coding (Thematic Matrix) – 2 Groups

Table 4: Level 1- Mathematics Students' Comments

Solve problem	Lecturer Quality	Positive Aspects
The Lecturer know how to teach very well		
Solve my problem; This unit is very beautiful	Learned New Things	
New and different topics - new way to learn		
Only the lecturer.	Good Module/Subject – Improve Math/logical skills	
The lecturer; good module		
Learning a new thing		
I understand new things; It improves our Mathematical skills and logical skills also		
The module helps me to develop and enhance my academic skills		
I understand new things		

**Column 1 = Comments, Column 2 = Codes Formulated, Column 3 = Themes*

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Table 5: Level 2- Mathematics Students' Comments

youtube Review the notes and lecture Nothing Worksheets	Asynchronous materials, e.g. Videos, slides Practice exercises/activities	Aspects of the Classroom Experience which helped learners
 Less subject If the teacher could slow down when explaining the lecture. Nothing Not much	Less content Needed/time management Teacher teaching style	What could have been done making the module more effective?
 knowing how to solve the problems The way of the teaching Nothing Its very interesting to learn	Good Module/Subject – Improve Math/logical skills Lecturer Quality Learned New Things/New Skills/Interesting Things	Positive Aspects

**Column 1 = Comments, Column 2 = Codes Formulated, Column 3 = Themes*

B. Data Treatment (Foundation Scores Correlated with Mathematics Performance)

All level 1 Mathematics from Sep 2021 to June 2022 where all combined in 1 sheet and the same was done with all level-2 Mathematics. This is necessary as their Foundation results are not present along with their current Mathematics result. Most of these students have taken their Foundation modules in their previous years and hence a special technique is used. All results of the students from previous years were downloaded from the College database archives and thereby combined. The combined/integrated results are then imported to the level 1 and 2 Mathematics results and using a VLOOKUP function, results are then matched and placed along with the Mathematics GPAs. These are then imported to SPSS for further analysis, i.e., correlations, etc.

C. Data Treatment (Communication Skills Correlated with Mathematics Performance)

In terms of looking at whether or not Mathematics performance is linked to effective communication which is one of the students' responsibilities according to Devesh (2015), a voluminous 2-year data was obtained from the College database pertinent to the average result of every student in their 4 English modules, i.e. English Reading & Writing (ENG101), Professional Communication Skills in English (ENG102), Integrated Language Skills (ENG103), and Academic Reading & Writing (ENG104). These average results are then correlated with the average result of every student in their Mathematics modules, i.e., Level 1 Mathematics, Module 1- Level 2 Mathematics, and Module 2 – Level 2 Mathematics. Level 1 Mathematics performance is correlated with level 1 English modules' grades (ENG101 & ENG102), while Level 2 Mathematics performances are correlated with Level 2 English modules' grades (ENG103 & ENG104). Grades of these modules starting 2021 were downloaded from the College database in the same manner as mentioned above. Grades are then matched and combined in a single sheet per level using again a VLOOKUP function. It should be noted that only Mathematics students who

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took the above-mentioned English modules were included in order to have an accurate correlation results. Those who did not meet the requirements were cancelled from the list using an MS Excel filter feature. Every worksheet is then imported to SPSS and further analyzed.

D. Data Treatment (Attendance Percentage Correlated with Mathematics Performance)

Attendance and Mathematics results are downloaded separately. For students' grades (Mathematics performance) data, it is directly downloaded from the College database through the Module Grade Sheet Filters section where grades are individually filtered according to the desired modules. For attendance data, since there are multiple class groups, it was separately downloaded from a different menu, the (Module-wise Attendance Report) according to the students' groups and thereafter combined. Furthermore, to avoid discrepancies, the days when students were marked "EXCUSED" were considered "ABSENT" in order to have accurate attendance percentages as these are not reflected in the database. The following formulas are used.

Full-time formula:

COUNTIF (E6:DP6,"P")/(60-COUNTIF(E6:DP6,"H")-COUNTIF(E6:DP6,"N"))
Where E6:DP6 are the attendance entries

Part-time Formula:

COUNTIF (E6:DP6,"P")/(45-COUNTIF(E6:DP6,"H")-COUNTIF(E6:DP6,"N"))

Where E6:DP6 are the attendance entries
Note: Full time is 60 hours (4 hrs. per week x 15 weeks every semester)
Part time is 45 hours (3 hrs. per week x 15 weeks every semester)

E. Data Treatment (Dichotomous Data: Gender and Mode of Study)

Categorical data was also obtained from the College database and these include mode of study (Part time and Full time), Gender (Male & Female), and Nationality (Omani and Non-Omani). Nationality is not included in the calculation due to huge gaps between the values, only 2% to 5% were expatriates, so only gender and mode of study were correlated with the Mathematics performance. The main purpose is to determine whether or not these demographic factors which are nominal data have impact on students' Mathematics performance. These data were obtained from the same Registered Students list, downloaded accordingly based on cohorts. VLOOKUP function was again used to import the data to the same workbook for Mathematics grades. These data were then imported to SPSS and using bi-serial correlation and ANOVA, statistical analysis was then properly performed and results of these are elaborated in the Results and Discussion section. The following codes are used in SPSS for the binomial outcomes, in particular bi-serial correlation coefficient:

Gender: (Male = 1 and Female = 0)

Mode of Study: (Full-time = 1 and Part-time = 0)