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# A STUDY OF IMPACT OF ONLINE LEARNING ON THE ACADEMIC PERFORMANCE OF THE UNDERGRADUATE STUDENTS THROUGH PARTIAL LEAST SQUARE STRUCTURAL EQUATION MODELING ( PLS-SEM AND NECESSARY CONDITIONS ANALYSIS (NCA)

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## ABSTRACT
*The present study aims to study the effect of Online learning on the Academic performance of the learners. The combination of PLS-SEM and NCA analysis was used to analyze the effect of course material, ease of use, ease of learning, faculty teaching and student's expectation on the academic performance with student's satisfaction as a mediating variable. A sample of 627 respondents were collected from undergraduate learners of University of Mumbai. The findings revealed that course material, ease of use, ease of learning, faculty teaching, student's perception are necessary and sufficient factors for predicting the effect on the academic performance of the learners. Student's Expectation, Ease of Learning and Satisfaction are important variable and the performance is excellent whereas Ease of use, course material and Faculty teaching were important but the performance was poor.*

*Keywords: Online Learning, Academic Performance , PLS-SEM and NCA*

## INTRODUCTION
Online learning during the Covid-19 pandemic was conducted for the undergraduate students through Online platforms like Zoom meetings, Microsoft teams, Google meet, Webex etc. The satisfaction level of the learners for Online learning was different for different learners. The satisfaction level had affected the academic performance of the undergraduate learners.

The studies conducted in the past revealed that the Online learning had positive as well as negative effect on the academic performance Asaad Mubarak Elshareef Mohammed (2022). Independent factors like course design, Prompt feedback and Student's satisfaction had a positive effect on the academic performance of the learners Ram Gopal Singh, Varsha Singh and Arun Aggarwal (2021). Online learning motivates learners to learn independently Balalakshmi and R Savithri (2021). Student's satisfaction was different for different level of online learning. Online learning Level was moderate among the learners Gio L. Ledesma (2021) .

Our present studies tried to remove these inconsistencies by identifying the gaps in the past studies by analysing the Impact of Independent factors like Course material, Ease of Use, Ease of Learning, Faculty teaching and Student's Perception on the academic performance of the learners with Student's Satisfaction as a mediating variable.

We have conducted PLS-SEM and NCA analysis to determine the necessary and sufficient factors for the academic performance of the learners and the critical level of the independent factors through bottleneck analysis. We also have analysed the important and performing factors for the academic performance through IMPA analysis .

## THEORETICAL MODEL & METHOD :
To test the hypothesis proposed above we have developed a theoretical model which analyzes the impact of Course material, Ease of Learning, Ease of use, Faculty teaching, Students perception on the Student's Satisfaction which in turn has impact on the academic performance of the students (figure 1)

PLS - SEM Method was used for testing & analyzing the relationships between independent variables & dependent variables. Partial Least Squares (PLS) helps the researchers to analyze the relationships simultaneously. It also helps to analyze the mediation relationships with the regression analysis (Nur Ainna Ramli, Hengky Latan & Gilbert V. Nartea, 2018). PLS- SEM techniques are more appropriate for determining the causal predictive model ( Chin, et al. 2020). PLS-SEM path modeling is useful technique to analyze and estimate the causal models (Hair et al 2021). PLS-SEM is beneficial for estimating models with many constructs, structural model relationships and many indicators per construct (Marko Sarsted and Joseph F.HairJr 2014). PLS SEM evaluation criteria provides the appropriate metrics for checking the result's robustness (Joseph F. Hair, Jeffrey J. Risher, Marko Sarstedt, Christian M. Ringle, 2019). Based on the findings of the above researchers we have decided to use PLS- SEM for the present study.

NCA analysis helps to identify the necessary conditions which are essential to achieve the desired outcome (Dul et.al 2016). The combined use of PLS-SEM and NCA helps the researchers in identifying the necessary factors

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required for an outcome (Ritcher et al 2020). We have used PLS- SEM and NCA analysis to determine the necessary & sufficient conditions to achieve the desired level of outcome. IPMA was performed to determine the relative importance - performance dimension of the constructs. SmartPLS 3.0 software was used to analyze the model estimation (Ringle 2015).

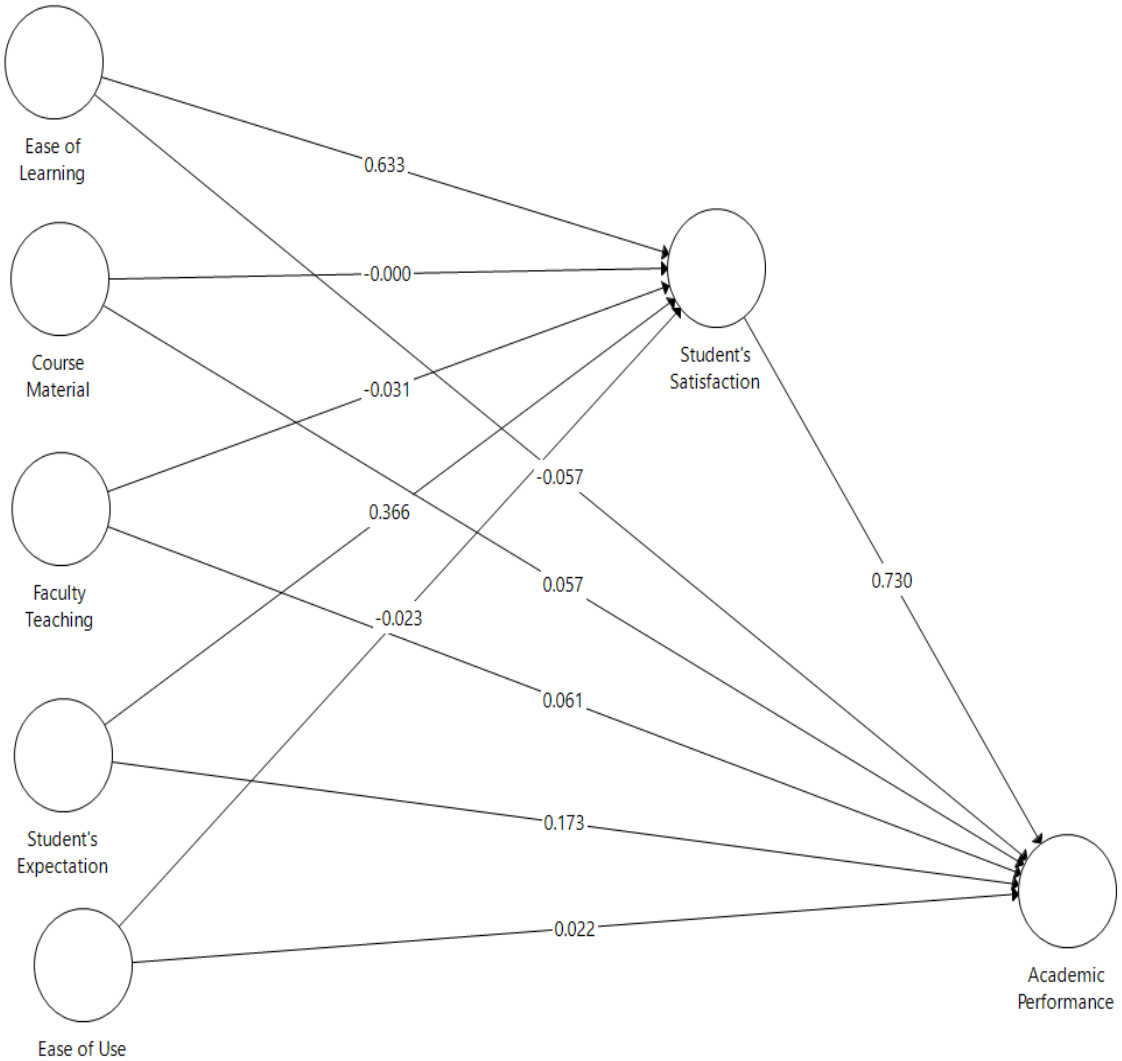
**MODEL RESULT ASSESSMENT:**

A questionnaire with survey items having 5 - point Likert Scale was designed for the study (Table 1). For evaluation of survey items, a Pilot test was conducted by circulating 100 questionnaires among the learners of University of Mumbai. Corrections in the survey items were made based on the responses from the pilot test. The final Sample consisted of 627 learners form various programmes like BCom, BMS, BBI, BFM of University of Mumbai. There were no missing values in the final data collection since all the questions in the questionnaire were set to mandatory

**Table 1 : Demographic Distribution :**

| **Gender** | | **Programme** | | | | **Class** | |
|---|---|---|---|---|---|---|---|
| Male | Female | BBI | BMS | BCOM | BFM | SY | TY |
| 317 | 310 | 133 | 258 | 120 | 116 | 368 | 259 |

Fig 1: PLS-SEM Model




**Findings of PLS-SEM:**

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The present research study adopted Joseph Hair (2017,2019 et al) for assessment of the measurement model. To measure the common method bias in our study we followed Podsakoff and Organ,1986; Podsakoff et al 2003) and Kock (2015). Gender and Class were used as control variables related to student's academic performance to measure the collinearity among the variables. The inner variance inflation factors (VIF) are less than 3.3 (Kock 2015) (Table 2). We therefore conclude that our sample is free of common method bias and do not have any critical collinearity issues.

**Table 2: Control Variables: Gender and Class**

| Indicator | Gender | | Class |
|---|---|---|---|
| | VIF < 3 | | VIF < 3 |
| | | | |
| CM1 | 2.967 | | 2.967 |
| CM2 | 2.867 | | 2.867 |
| CM3 | 2.803 | | 2.803 |
| EOU1 | 1.859 | | 1.859 |
| EOU2 | 1.814 | | 1.814 |
| EOU3 | 1.048 | | 1.048 |
| EOU4 | 1.633 | | 1.633 |
| F1 | 2.873 | | 2.873 |
| F2 | 2.842 | | 2.842 |
| F3 | 2.356 | | 2.356 |
| F4 | 2.088 | | 2.088 |
| L1 | 2.875 | | 2.875 |
| L2 | 2.232 | | 2.232 |
| L3 | 3.055 | | 2.85 |
| L4 | 2.981 | | 2.981 |
| P1 | 2.989 | | 2.989 |
| P2 | 3.644 | | 2.644 |
| P3 | 3.557 | | 2.557 |
| P4 | 2.386 | | 2.386 |
| SE1 | 2.185 | | 2.185 |
| SE2 | 1.73 | | 1.73 |
| SE3 | 1.926 | | 1.926 |
| SS1 | 2.89 | | 2.879 |
| SS2 | 2.87 | | 2.988 |
| SS3 | 2.789 | | 2.789 |
| SS4 | 2.883 | | 2.883 |
| | | | |

**Source : Own Calculations**

The bootstrapping procedure with 10000 sub samples, two -tailed test option with 95 % significance level was followed to test the significance level. The reflective measurement model was measured by analyzing the Convergent Validity and Internal Consistency reliability. The convergent validity was measured through indicator loadings and indicator reliability and the Internal consistency was measured through AVE, Cronbach Alpha and the composite reliability. All the indicator loading were above the threshold value of 0.70 and the indicator reliability values were more than 0.5 (Table 3). The latent variables had average extracted variance above the threshold value of 0.5 and the Cronbach Alpha value was within the threshold limit of 0.7 and 0.95 (Hair,et,al ,2017 (Table 3). we therefore assume that all the latent variables had reliability and convergent validity.

The discriminant validity was analyzed by using Heterotrait – Monotrait rate of correlations (HTMT) (Franke and Sarstedt 2019 ; Henseler , et al., 2015) . The HTMT values for all the latent variables were below the threshold value of 0.9 (Table 5) and we therefore assume that the latent variables have discriminant validity.

The $R^2$ values were analyzed by comparing the $R^2$ values of the previous similar studies. We found that the $R^2$ values of our study .8281 and 0.87 were similar to the $R^2$ values of the studies conducted in the past .

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**Table 3 : Construct Reliability**

| Latent Variable | Indicators | Convergent Validity | | Internal Consistency Reliability | | | |
|---|---|---|---|---|---|---|---|
| | | Loadings | Indicator Reliability | AVE | Cronbach's Alpha | rho_A | Composite Reliability |
| | | > 0.70 | > 0.50 | > 0.50 | 0.70 - 0.95 | | |
| Course Material | CM1 | 0.843 | 0.711 | 0.757 | 0.903 | 0.906 | 0.903 |
| | CM2 | 0.842 | 0.709 | | | | |
| | CM3 | 0.924 | 0.854 | | | | |
| Ease of Learning | EOL1 | 0.849 | 0.721 | 0.7 | 0.903 | 0.904 | 0.903 |
| | EOL2 | 0.784 | 0.615 | | | | |
| | EOL3 | 0.853 | 0.728 | | | | |
| | EOL4 | 0.859 | 0.738 | | | | |
| Ease of Use | EOU2 | 0.8 | 0.64 | 0.552 | 0.705 | 0.718 | 0.71 |
| | EOU4 | 0.712 | 0.507 | | | | |
| Faculty Teaching | FT1 | 0.889 | 0.79 | 0.682 | 0.895 | 0.897 | 0.895 |
| | FT2 | 0.819 | 0.671 | | | | |
| | FT3 | 0.817 | 0.667 | | | | |
| | FT4 | 0.774 | 0.599 | | | | |
| Academic Performance | P1 | 0.921 | 0.848 | 0.732 | 0.916 | 0.918 | 0.916 |
| | P2 | 0.828 | 0.686 | | | | |
| | P3 | 0.824 | 0.679 | | | | |
| | P4 | 0.847 | 0.717 | | | | |
| Student's Expectation | SE1 | 0.793 | 0.629 | 0.622 | 0.828 | 0.842 | 0.83 |
| | SE2 | 0.71 | 0.504 | | | | |
| | SE3 | 0.881 | 0.776 | | | | |
| | SS1 | 0.888 | 0.789 | 0.788 | 0.937 | 0.937 | 0.937 |
| Student's Satisfaction | SS2 | 0.863 | 0.745 | | | | |
| | SS3 | 0.887 | 0.787 | | | | |
| | SS4 | 0.912 | 0.832 | | | | |
| | | | | | | | |

**Source: Own Calculations**

**Table 4 : Construct Reliability of Items**

| Items | Indicators | Convergent Validity | | Internal Consistency Reliability | |
|---|---|---|---|---|---|
| | | Loadings | Indicator Reliability | AVE | Composite Reliability |
| | | > 0.70 | > 0.50 | > 0.50 | |
| The course material(ppt) displayed during online learning was easy to understand | CM1 | 0.843 | 0.711 | 0.757 | 0.903 |
| The course material was well designed and organized during Online learning | CM2 | 0.842 | 0.709 | | |
| The course material(ppt) displayed during online learning helped me to learn quickly | CM3 | 0.924 | 0.854 | | |
| Online Learning was easy | EOL1 | 0.849 | 0.721 | 0.7 | 0.903 |
| Online learning was quick | EOL2 | 0.784 | 0.615 | | |
| Online learning helped me to understand complex concepts | EOL3 | 0.853 | 0.728 | | |
| Online learning helped me to remember things easily | EOL4 | 0.859 | 0.738 | | |

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| | | | | | |
|---|---|---|---|---|---|
| Online learning was easy through devices like Laptop/Mobile Phones | EOU2 | 0.8 | 0.64 | 0.552 | 0.71 |
| I could use the Zoom Online platform successfully every time | EOU4 | 0.712 | 0.507 | | |
| Faculty teaching was effective during Online teaching | FT1 | 0.889 | 0.79 | 0.682 | 0.895 |
| The communication skills of the faculty were effective | FT2 | 0.819 | 0.671 | | |
| The faculty was enthusiastic while Online teaching | FT3 | 0.817 | 0.667 | | |
| I receive prompt feedback from the faculty during online teaching | FT4 | 0.774 | 0.599 | | |
| Online learning helped me to improve my Analytical Skills | P1 | 0.921 | 0.848 | 0.732 | 0.916 |
| Online learning helped me to improve my Communication Skills | P2 | 0.828 | 0.686 | | |
| Online learning has improved my confidence level | P3 | 0.824 | 0.679 | | |
| Online learning had improved my overall academic performance | P4 | 0.847 | 0.717 | | |
| I expected that understanding of concepts through Online learning would be easy and quick | SE1 | 0.793 | 0.629 | 0.622 | 0.83 |
| I expected that Faculty will provide quick feedback during Online learning | SE2 | 0.71 | 0.504 | | |
| I believed that Online learning would improve my overall performance | SE3 | 0.881 | 0.776 | | |
| Online Classes were Valuable | SS1 | 0.888 | 0.789 | 0.788 | 0.937 |
| Online Classes increased my interest in learning | SS2 | 0.863 | 0.745 | | |
| Online Classes increased my understanding ability of various concepts | SS3 | 0.887 | 0.787 | | |
| Overall, I am satisfied with Online Learning | SS4 | 0.912 | 0.832 | | |
| | | | | | |

**Source: Own Calculations**

**Table 5: Discriminant Validity**

| **Latent Variables** | | **HTMT Values < 0.9** |
|---|---|---|
| Ease of Learning <->Course Material | | 0.757 |
| Ease of Use <-> Course Material | | 0.719 |
| Ease of Use <-> Ease of Learning | | 0.666 |
| Faculty teaching <-> Course Material | | 0.791 |
| Faculty teaching <-> Ease of Learning | | 0.748 |
| Faculty teaching <-> Ease of Use | | 0.669 |
| Academic Performance <-> Course Material | | 0.739 |
| Academic Performance <-> Ease of Learning | | 0.830 |
| Academic Performance <-> Ease of Use | | 0.657 |
| Academic Performance <-> Faculty Teaching | | 0.712 |
| Student's Expectation <-> Course Material | | 0.789 |
| Student's Expectation <-> Ease of Learning | | 0.800 |
| Student's Expectation <-> Ease of Use | | 0.726 |
| Student's Expectation <-> Faculty Teaching | | 0.748 |
| Student's Expectation <-> Academic Performance | | 0.839 |
| Student's Satisfaction <-> Course Material | | 0.721 |
| Student's Satisfaction <-> Ease of Learning | | 0.886 |
| Student's Satisfaction <-> Ease of Use | | 0.639 |
| Student's Satisfaction <-> Faculty Teaching | | 0.694 |
| Student's Satisfaction <-> Academic Performance | | 0.890 |
| Student's Satisfaction <->Student's Expectation | | 0.829 |

**Source: Own Calculations**

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**Robustness Check of the PLS-SEM Model**

**Unobserved Heterogeneity**

To measure the unobserved heterogeneity among the groups we followed the guidelines given by Saresdt,et al., (2019). We measured the Heterogeneity among the groups using Prediction-Oriented Segmentation (PLS-POS) and Multi-Group Analysis (MGA). The MGA algorithm was ran for three groups, Group1 ,Group 2 and Group 3. For all the path coefficients the difference in p-vlaue of Group1 vs Group 2 , Group 2 vs Group 3 and Group vs Group 3 is above the threshold value of 0.05 (Table 6 ). We therefore assume that the there is no unobserved heterogeneity among the groups and there is homogeneity in our sample.

**Table 6 : Measurement of Unobserved Heterogeneity using POS and MGA**

| Path | Total Effects (Group1-Group2) | Original p-value (Group1 vs Group3) | New p-value (Group1 vs Group2) | New p-value (Group1 vs Group3) |
|---|---|---|---|---|
| CM -> PERF | 0.378 | 0.16 | 0.1 | 0.11 |
| CM -> SS | 0.201 | 0.536 | 0.153 | 0.928 |
| EOL -> PERF | 0.064 | 0.372 | 0.485 | 0.744 |
| EOL -> SS | 0.161 | 0.127 | 0.168 | 0.253 |
| EOU -> PERF | 0.186 | 0.995 | 0.126 | 0.11 |
| EOU -> SS | 0.171 | 0.995 | 0.125 | 0.19 |
| FT -> PERF | 0.018 | 0.39 | 0.843 | 0.178 |
| FT -> SS | 0.132 | 0.104 | 0.202 | 0.208 |
| SE -> PERF | 0.085 | 0.953 | 0.386 | 0.193 |
| SE -> SS | 0.326 | 0.529 | 0.1 | 0.942 |
| SS -> PERF | 0.522 | 0.134 | 0.12 | 0.269 |

**Source : Own Calculations**

**Non-Linearity**

The Non-Linearity in the structural model was measured through guidelines provided by Svennson (2018) . We ran Ramsey's test for the latent variable extracted through PLS_SEM algorithm. We found that for all the Non-Linear relationship the F value and p-value is above the threshold value of 0.05 (Table 7) .We therefore conclude that there is no non-linearity issues in our model .

**Table 7: The Non-linearity assessment through Ramsey test**

| Non-linear relationship | Co-efficient | p-value | $f^2$ | Ramsey's RESET |
|---|---|---|---|---|
| FT*FT->SS | 0.023 | 0.41 | 0.002 | F= O.813051, p-value = 0.6188 |
| SE*SE->SS | 0.018 | 0.445 | 0..01 | |
| CM*CM->SS | 0.004 | 0.894 | 0.000 | |
| EOL*EOL->SS | 0.021 | 0.421 | 0.001 | |
| EOU*EOU->SS | 0.001 | 0.947 | 0.000 | |
| FT*FT->PERF | 0.001 | 0.965 | 0.000 | F= 0.58911, p-value = 0.8519 |
| CM*CM->PERF | 0.029 | 0.282 | 0.003 | |
| EOL*EOL->PERF | 0.008 | 0.736 | 0.000 | |
| EOU*EOU->PERF | 0.000 | 0.999 | 0.000 | |
| SS*SS->PERF | 0.016 | 0.576 | 0.001 | |
| SE*SE->PERF | 0.031 | 0.15 | 0.004 | |
| | | | | |

**Source: Own Calculations**

**Endogeneity**

To measure the Endogeneity in our study we applied the Park and Gupta (2012) Gaussian Copula approach. We first extracted the latent variable of the independent variables Course material (CM), Ease of Learning (EOL), Ease of Use (EOU), Faculty Teaching (FT) and Student's Expectations (SE) and applied the Kolmogorov-Smirnova test. We found that the p-value for all the independent variables was less than the critical level of 0.05

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(p-value <0.05) (Table 8). we assumed that there is non-normality among the independent variables. We then measured the endogeneity through Gaussian Copula method. We found that all the values of all the Gaussian Copulas were above the critical value of 0.05. (p> 0.05) and (Bootstrapped value > 0.05) (Table 9). Hence values of all the Gaussian Copulas are significant. We concluded that there is no endogeneity among the variables and our structural model is robust.

**Table 8: Test of Normality for Independent variables using Kolmogorov-Smirnova Test**

| Construct | Statistic | df | Sig. |
|---|---|---|---|
| CM | 0.145 | 627 | 0.000 |
| EOL | 0.071 | 627 | 0.000 |
| EOU | 0.137 | 627 | 0.000 |
| FT | 0.099 | 627 | 0.000 |
| SE | 0.091 | 627 | 0.000 |
| a Lilliefors Significance Correction | | | |

**Table 9: Measurement of Endogeneity Test using Gaussian Copula Method**

| Model | Indicators | Estimate | Pr(>\|t\|) > 0.05 | Bootstrapped > 0.05 |
|---|---|---|---|---|
| 1 | CM | 0.070748 | 0.0582 | |
| | EOL | 0.064698 | 0.0772 | |
| | EOU | 0.034332 | 0.1935 | |
| | FT | 0.062999 | 0.0382 | |
| | SE | 0.154053 | 1.90E-06 | |
| | SS | 0.578988 | < 2e-16 | |
| | CM_star | 0.001827 | 0.8632 | 0.8576624 |
| 2 | CM | 0.07426 | 0.0214 | |
| | EOL | 0.061365 | 0.1909 | |
| | EOU | 0.034047 | 0.1964 | |
| | FT | 0.063243 | 0.037 | |
| | SE | 0.154046 | 1.95E-06 | |
| | SS | 0.579326 | < 2e-16 | |
| | EOL_star | 0.002413 | 0.9004 | 0.8585342 |
| 3 | CM | 0.075422 | 0.0195 | |
| | EOL | 0.064057 | 0.0799 | |
| | EOU | 0.022588 | 0.4954 | |
| | FT | 0.062889 | 0.0378 | |
| | SE | 0.15369 | 1.98E-06 | |
| | SS | 0.578749 | < 2e-16 | |
| | EOU_star | 0.006368 | 0.5681 | 0.8604962 |
| 4 | CM | 0.073859 | 0.0218 | |
| | EOL | 0.063443 | 0.0848 | |
| | EOU | 0.034237 | 0.194 | |
| | FT | 0.055289 | 0.1429 | |
| | SE | 0.154404 | 1.76E-06 | |
| | SS | 0.57935 | < 2e-16 | |
| | FT_star | 0.004779 | 0.7169 | 0.6683505 |
| 5 | CM | 0.074301 | 0.02113 | |
| | EOL | 0.064853 | 0.07603 | |
| | EOU | 0.03443 | 0.19191 | |
| | FT | 0.063267 | 0.03661 | |
| | SE | 0.146585 | 0.00039 | |
| | SS | 0.578634 | < 2e-16 | |
| | SE_star | 0.004308 | 0.7649 | 0.7217328 |
| 6 | CM | 0.074691 | 0.0205 | |

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| | | | | |
|---|---|---|---|---|
| | EOL | 0.063366 | 0.0842 | |
| | EOU | 0.034313 | 0.193 | |
| | FT | 0.062774 | 0.0382 | |
| | SE | 0.153385 | 2.12E-06 | |
| | SS | 0.568215 | < 2e-16 | |
| | SS_star | 0.007582 | 0.6169 | |
| | | | | |

**Note: star is the Gaussian Copula term using for measuring the Endogeneity**

| Model | Indicators | Estimate | Pr(>\|t\|) > 0.05 | Bootstrapped >0.05 |
|---|---|---|---|---|
| 7 | CM | 0.071361 | 0.0704 | |
| | EOL | 0.06312 | 0.197 | |
| | EOU | 0.034284 | 0.1948 | |
| | FT | 0.062971 | 0.0384 | |
| | SE | 0.153977 | 0.00000201 | |
| | SS | 0.579103 | < 2e-16 | |
| | CM_star | 0.001546 | 0.8981 | 0.894936 |
| | EOL_star | 0.001069 | 0.9612 | 0.9464085 |
| 8 | CM | 0.078575 | 0.049 | |
| | EOL | 0.064238 | 0.0795 | |
| | EOU | 0.020753 | 0.5626 | |
| | FT | 0.063236 | 0.0376 | |
| | SE | 0.153833 | 0.000002 | |
| | SS | 0.578809 | <2e-16 | |
| | CM_star | -0.001657 | 0.8928 | 0.8905554 |
| | EOU_star | 0.00725 | 0.5753 | 0.5578812 |
| 9 | CM | 0.0756144 | 0.0602 | |
| | EOL | 0.0633712 | 0.0855 | |
| | EOU | 0.0341179 | 0.1967 | |
| | FT | 0.0542061 | 0.1816 | |
| | SE | 0.154557 | 0.00000184 | |
| | SS | 0.5794555 | < 2e-16 | |
| 10 | CM_star | -0.000997 | 0.9419 | 0.9413914 |
| | FT_star | 0.0055623 | 0.7437 | 0.7112859 |
| | CM | 7.45E-02 | 0.0652 | |
| | EOL | 6.49E-02 | 0.0767 | |
| | EOU | 3.44E-02 | 0.1927 | |
| | FT | 6.33E-02 | 0.0376 | |
| | SE | 1.47E-01 | 0.0011 | |
| | SS | 5.79E-01 | <2e-16 | |
| | CM_star | -9.95E-05 | 0.994 | 0.9940301 |
| | SE_star | 4.39E-03 | 0.807 | 0.7837252 |
| 11 | CM | 0.077183 | 0.0519 | |
| | EOL | 0.063398 | 0.0843 | |
| | EOU | 0.034148 | 0.1962 | |
| | FT | 0.063028 | 0.0382 | |
| | SE | 0.153446 | 0.00000215 | |
| | SS | 0.566845 | < 2e-16 | |
| | CM_star | -0.001345 | 0.9142 | 0.9153966 |
| | SS_star | 0.008596 | 0.6302 | 0.5458832 |
| 12 | CM | 0.075261 | 0.02 | |
| | EOL | 0.069637 | 0.1557 | |
| | EOU | 0.020721 | 0.5528 | |
| | FT | 0.063148 | 0.0374 | |

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| | | | | |
|---|---|---|---|---|
| | SE | 0.15399 | 0.00000199 | |
| | SS | 0.578351 | < 2e-16 | |
| | EOL_star | -0.003762 | 0.8643 | 0.9940377 |
| | EOU_star | 0.007417 | 0.5604 | 0.7861457 |
| 13 | CM | 0.073689 | 0.0227 | |
| | EOL | 0.065527 | 0.1764 | |
| | EOU | 0.034264 | 0.194 | |
| | FT | 0.054559 | 0.1655 | |
| | SE | 0.154572 | 0.00000188 | |
| | SS | 0.579243 | < 2e-16 | |
| | EOL_star | -0.001477 | 0.9472 | 0.9301354 |
| | FT_star | 0.005287 | 0.729 | 0.6975805 |
| 14 | CM | 0.074206 | 0.021593 | |
| | EOL | 0.066744 | 0.189149 | |
| | EOU | 0.034483 | 0.191894 | |
| | FT | 0.06336 | 0.036799 | |
| | SE | 0.145767 | 0.000946 | |
| | SS | 0.578462 | < 2e-16 | |
| | EOL_star | -0.001255 | 0.957258 | 0.9437908 |
| | SE_star | 0.00484 | 0.782117 | 0.7549793 |
| 15 | CM | 0.074367 | 0.0213 | |
| | EOL | 0.070754 | 0.1586 | |
| | EOU | 0.034425 | 0.1919 | |
| | FT | 0.063039 | 0.0377 | |
| | SE | 0.153643 | 0.00000211 | |
| | SS | 0.564243 | < 2e-16 | |
| | EOL_star | -0.005195 | 0.8289 | 0.7849929 |
| | SS_star | 0.010019 | 0.5961 | 0.5139679 |
| 14 | CM | 0.075264 | 0.0201 | |
| | EOL | 0.063727 | 0.0837 | |
| | EOU | 0.023601 | 0.506 | |
| | FT | 0.060827 | 0.1259 | |
| | SE | 0.153768 | 0.00000201 | |
| | SS | 0.578842 | < 2e-16 | |
| | EOU_star | 0.005831 | 0.6543 | 0.6370863 |
| | FT_star | 0.001233 | 0.9361 | 0.9271728 |
| 15 | CM | 0.0754172 | 0.019656 | |
| | EOL | 0.0640611 | 0.080159 | |
| | EOU | 0.0227796 | 0.522785 | |
| | FT | 0.0628864 | 0.037937 | |
| | SE | 0.1532612 | 0.000439 | |
| | SS | 0.5787278 | < 2e-16 | |
| | EOU_star | 0.0062735 | 0.626847 | 0.6264853 |
| | SE_star | 0.0002445 | 0.988296 | 0.9871515 |
| 16 | CM | 0.07545 | 0.0196 | |
| | EOL | 0.06336 | 0.0845 | |
| | EOU | 0.02563 | 0.4697 | |
| | FT | 0.06264 | 0.0388 | |
| | SE | 0.15333 | 0.00000218 | |
| | SS | 0.57269 | < 2e-16 | |
| | EOU_star | 0.00476 | 0.7139 | 0.7125571 |
| | SS_star | 0.00428 | 0.8083 | 0.7585453 |
| 17 | CM | 0.074039 | 0.0218 | |
| | EOL | 0.063693 | 0.0843 | |
| | EOU | 0.034385 | 0.1928 | |

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| | | | | |
|---|---|---|---|---|
| | FT | 0.056962 | 0.1538 | |
| | SE | 0.150483 | 0.0007 | |
| | SS | 0.579058 | <2e-16 | |
| | FT_star | 0.003742 | 0.8087 | 0.7882888 |
| | SE_star | 0.002176 | 0.8975 | 0.8849686 |
| 18 | CM | 0.074538 | 0.021 | |
| | EOL | 0.063013 | 0.0873 | |
| | EOU | 0.034342 | 0.193 | |
| | FT | 0.05985 | 0.1327 | |
| | SE | 0.153553 | 0.00000216 | |
| | SS | 0.56986 | < 2e-16 | |
| | FT_star | 0.001766 | 0.9098 | 0.9034764 |
| | SS_star | 0.006499 | 0.717 | 0.6531334 |
| 19 | CM | 0.07469 | 0.02061 | |
| | EOL | 0.06336 | 0.0848 | |
| | EOU | 0.03431 | 0.19378 | |
| | FT | 0.06277 | 0.03839 | |
| | SE | 0.1534 | 0.00061 | |
| | SS | 0.5682 | < 2e-16 | |
| | SE_star | -3.11E-05 | 0.99863 | 0.9984906 |
| | SS_star | 0.007601 | 0.68858 | 0.6182124 |
| | | | | |

| **Model** | **Indicators** | **Estimate** | **Pr(>\|t\|) > 0.05** | **Bootstrapped >0.05** |
|---|---|---|---|---|
| 20 | CM | 0.077405 | 0.0582 | |
| | EOL | 0.068842 | 0.1682 | |
| | EOU | 0.019795 | 0.5882 | |
| | SE | 0.154037 | 0.00000202 | |
| | SS | 0.578456 | < 2e-16 | |
| | FT | 0.063338 | 0.0375 | |
| | CM_star | -0.001113 | 0.9315 | 0.930141 |
| | EOL_star | -0.003144 | 0.892 | 0.8525719 |
| | EOU_star | 0.007837 | 0.566 | 0.5464482 |
| 21 | CM | 0.07411 | 0.07097 | |
| | EOL | 0.06677 | 0.19199 | |
| | EOU | 0.03449 | 0.19271 | |
| | SE | 0.1458 | 0.00169 | |
| | SS | 0.5785 | < 2e-16 | |
| | FT | 0.06335 | 0.03767 | |
| | CM_star | 0.00005285 | 0.99688 | 0.9968346 |
| | EOL_star | -0.001274 | 0.9576 | 0.9438155 |
| | SE_star | 0.004805 | 0.80647 | 0.7899805 |
| 22 | CM | 0.0757637 | 0.0606 | |
| | EOL | 0.070286 | 0.1671 | |
| | EOU | 0.0343267 | 0.1945 | |
| | SE | 0.1536599 | 0.00000215 | |
| | SS | 0.5637489 | < 2e-16 | |
| | FT | 0.0631616 | 0.038 | |
| | CM_star | -0.0007423 | 0.954 | 0.9538849 |
| | EOL_star | -0.0048526 | 0.8447 | 0.7971729 |
| | SS_star | 0.010419 | 0.6051 | 0.5409503 |
| 23 | CM | 0.0751836 | 0.0679 | |
| | EOL | 0.0650113 | 0.1873 | |
| | EOU | 0.0341596 | 0.1968 | |

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| | | | | |
|---|---|---|---|---|
| | SE | 0.1546623 | 0.00000194 | |
| | SS | 0.5793537 | < 2e-16 | |
| | FT | 0.0538192 | 0.193 | |
| | CM_star | -0.0008281 | 0.9532 | 0.9523715 |
| | EOL_star | -0.0011537 | 0.96 | 0.9460664 |
| | FT_star | 0.0058263 | 0.7437 | 0.716361 |
| 24 | CM | 0.07959 | 0.055955 | |
| | EOL | 0.064322 | 0.079476 | |
| | EOU | 0.021416 | 0.559367 | |
| | SE | 0.15104 | 0.000975 | |
| | SS | 0.578685 | < 2e-16 | |
| | FT | 0.063332 | 0.037552 | |
| | CM_star | -0.002206 | 0.873482 | 0.8721092 |
| | EOU_star | 0.006914 | 0.609243 | 0.5999427 |
| | SE_star | 0.001619 | 0.931303 | 0.9256778 |
| 25 | CM | 0.081467 | 0.0469 | |
| | EOL | 0.063433 | 0.0843 | |
| | EOU | 0.023301 | 0.5264 | |
| | SE | 0.153458 | 0.00000218 | |
| | SS | 0.570475 | < 2e-16 | |
| | FT | 0.063209 | 0.0378 | |
| | CM_star | -0.003156 | 0.811 | 0.8126918 |
| | EOU_star | 0.005822 | 0.6716 | 0.6681806 |
| | SS_star | 0.005925 | 0.7545 | 0.7015771 |
| 26 | CM | 0.080504 | 0.0524 | |
| | EOL | 0.063556 | 0.0848 | |
| | EOU | 0.021901 | 0.5484 | |
| | SE | 0.154129 | 2.01E-06 | |
| | SS | 0.579081 | < 2e-16 | |
| | FT | 0.058412 | 0.1595 | |
| | CM_star | -0.002875 | 0.8398 | 0.8383793 |
| | EOU_star | 0.006575 | 0.6273 | 0.6146837 |
| | FT_star | 0.003038 | 0.8645 | 0.8470856 |
| 27 | CM | 0.0776825 | 0.05902 | |
| | EOL | 0.0634927 | 0.08456 | |
| | EOU | 0.0341751 | 0.19633 | |
| | SE | 0.1518693 | 0.00116 | |
| | SS | 0.5673148 | < 2e-16 | |
| | FT | 0.0630877 | 0.03833 | |
| | CM_star - | 0.0016093 | 0.90657 | 0.9082983 |
| | SE_star | 0.0009266 | 0.96268 | 0.9589079 |
| | SS_star | 0.0082106 | 0.67651 | 0.6084204 |
| 28 | CM | 0.077722 | 0.06471 | |
| | EOL | 0.063663 | 0.08466 | |
| | EOU | 0.034211 | 0.19598 | |
| | SE | 0.148957 | 0.00115 | |
| | SS | 0.579137 | < 2e-16 | |
| | FT | 0.055527 | 0.17906 | |
| | CM_star | -0.002044 | 0.89137 | 0.8928995 |
| | SE_star | 0.003197 | 0.86269 | 0.8469715 |
| | FT_star | 0.00486 | 0.78123 | 0.7541778 |
| 29 | CM | 0.079338 | 0.0549 | |
| | EOL | 0.062754 | 0.0891 | |
| | EOU | 0.03404 | 0.1981 | |
| | SE | 0.15383 | 0.00000217 | |

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| | | | | |
|---|---|---|---|---|
| | SS | 0.568655 | < 2e-16 | |
| | FT | 0.057669 | 0.1649 | |
| | CM_star | -0.002667 | 0.8521 | 0.8558254 |
| | SS_star | 0.007516 | 0.6886 | 0.6292304 |
| | FT_star | 0.003388 | 0.8496 | 0.8356408 |
| 30 | CM | 0.075185 | 0.020215 | |
| | EOL | 0.07117 | 0.167554 | |
| | EOU | 0.021625 | 0.549766 | |
| | SE | 0.150924 | 0.000846 | |
| | SS | 0.578085 | < 2e-16 | |
| | FT | 0.063196 | 0.037408 | |
| | EOL_star | -0.004777 | 0.844647 | 0.7957474 |
| | EOU_star | 0.007004 | 0.602322 | 0.5978971 |
| | SE_star | 0.001794 | 0.922566 | 0.9166348 |
| 31 | CM | 0.075129 | 0.0203 | |
| | EOL | 0.074708 | 0.1432 | |
| | EOU | 0.023783 | 0.5081 | |
| | SE | 0.153709 | 0.00000213 | |
| | SS | 0.567628 | < 2e-16 | |
| | FT | 0.06302 | 0.0379 | |
| | EOL_star | -0.007981 | 0.7485 | 0.6810499 |
| | EOU_star | 0.005865 | 0.6626 | 0.6555841 |
| | SS_star | 0.007259 | 0.7159 | 0.6637204 |
| 32 | CM | 0.074904 | 0.021 | |
| | EOL | 0.070723 | 0.154 | |
| | EOU | 0.022115 | 0.541 | |
| | SE | 0.154234 | 0.00000202 | |
| | SS | 0.578408 | < 2e-16 | |
| | FT | 0.059211 | 0.144 | |
| | EOL_star | -0.004929 | 0.833 | 0.7786523 |
| | EOU_star | 0.006696 | 0.624 | 0.6062285 |
| | FT_star | 0.002402 | 0.883 | 0.8708437 |
| 33 | CM | 0.075494 | 0.019629 | |
| | EOL | 0.063161 | 0.08605 | |
| | EOU | 0.024722 | 0.497184 | |
| | SE | 0.156874 | 0.000599 | |
| | SS | 0.571437 | < 2e-16 | |
| | FT | 0.062609 | 0.039052 | |
| | EOU_star | 0.005183 | 0.702082 | 0.7046521 |
| | SE_star | -0.002072 | 0.912325 | 0.9057569 |
| | SS_star | 0.005295 | 0.790315 | 0.7430716 |
| 34 | CM | 0.0752577 | 0.02025 | |
| | EOL | 0.0636999 | 0.08444 | |
| | EOU | 0.0234656 | 0.52243 | |
| | SE | 0.1542329 | 0.00066 | |
| | SS | 0.5788717 | < 2e-16 | |
| | FT | 0.060687 | 0.13788 | |
| | EOU_star | 0.0058955 | 0.66807 | 0.6646676 |
| | SE_star | -0.0002622 | 0.98827 | 0.9872003 |
| | FT_star | 0.001319 | 0.93615 | 0.9272033 |
| 35 | CM | 0.0745147 | 0.021141 | |
| | EOL | 0.0629106 | 0.088981 | |
| | EOU | 0.0342997 | 0.194283 | |
| | SE | 0.15477 | 0.000806 | |
| | SS | 0.5694695 | < 2e-16 | |

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| | | | | |
|---|---|---|---|---|
| | FT | 0.0595452 | 0.143292 | |
| | SE_star | -0.0006997 | 0.970465 | 0.9675632 |
| | SS_star | 0.0068305 | 0.733394 | 0.6829219 |
| | FT_star | 0.0019458 | 0.905206 | 0.8964252 |

| Model | Indicators | Estimate | Pr(>\|t\|) > 0.05 | Bootstrapped >0.05 |
|---|---|---|---|---|
| 43 | CM | 0.080429 | 0.06086 | |
| | EOL | 0.071181 | 0.16962 | |
| | EOU | 0.021513 | 0.56468 | |
| | SE | 0.150306 | 0.00147 | |
| | SS | 0.578358 | < 2e-16 | |
| | FT | 0.057899 | 0.16993 | |
| | CM_star | -0.00301 | 0.8432 | 0.842402 |
| | EOL_star | -0.0052 | 0.83575 | 0.7860856 |
| | EOU_star | 0.006923 | 0.62603 | 0.6166862 |
| | SE_star | 0.002441 | 0.90325 | 0.8960134 |
| | FT_star | 0.003558 | 0.84641 | 0.8277018 |
| 44 | CM | 0.0749998 | 0.021 | |
| | EOL | 0.0745465 | 0.156 | |
| | EOU | 0.0240243 | 0.519 | |
| | SE | 0.1550053 | 0.001 | |
| | SS | 0.5678789 | <2e-16 | |
| | FT | 0.0612364 | 0.14 | |
| | EOL_star | -0.0080647 | 0.758 | 0.6956391 |
| | EOU_star | 0.0057191 | 0.688 | 0.6855024 |
| | SE_star | -0.0006922 | 0.972 | 0.970132 |
| | SS_star | 0.0071758 | 0.739 | 0.6981899 |
| | FT_star | 0.0010776 | 0.95 | 0.9448788 |
| | | | | |

| Model | Indicators | Estimate | Pr(>\|t\|) > 0.05 | Bootstrapped >0.05 |
|---|---|---|---|---|
| 45 | EOL | 0.0742067 | 0.1581 | |
| | EOU | 0.0228884 | 0.54254 | |
| | SE | 0.1530329 | 0.00141 | |
| | SS | 0.5673883 | < 2e-16 | |
| | FT | 0.0592733 | 0.16211 | |
| | CM_star | -0.003499 | 0.81903 | 0.8205613 |
| | EOL_star | -0.0079004 | 0.76339 | 0.6996526 |
| | EOU_star | 0.0061647 | 0.66811 | 0.662675 |
| | SE_star | 0.0006312 | 0.97572 | 0.9743212 |
| | SS_star | 0.0076245 | 0.72455 | 0.6831244 |
| | FT_star | 0.0026585 | 0.88608 | 0.8754111 |
| | | | | |

**Source : Own Calculations**

**Hypothesis:**

Based on the past studies we propose the following hypothesis for our independent factors:

**Course Material**

*H1:* Course material has a positive effect on the academic performance

*H2:* Course material has a positive effect on the student's satisfaction

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**Ease of learning**
*H3*: Ease of Learning has a positive effect on the academic performance

*H4*: Ease of Learning has a positive effect on the student's satisfaction

**Ease of Use**
*H5*: Ease of Use has a positive effect on the academic performance

*H6*: Ease of Use has a positive effect on the student's satisfaction

**Faculty teaching**
*H7*: Faculty teaching has a positive effect on the academic performance

*H8*: Faculty teaching has a positive effect on the student's satisfaction

**Student's Expectation**
*H9*: Student's Expectation has a positive effect on the academic performance

*H10*: Student's Expectation has a positive effect on the student's satisfaction

**Student's Satisfaction**

***H11*: Student's Satisfaction has a positive effect on the academic performance**

The path coefficients for the proposed PLS-SEM model were measured through bootstrapping with 10000 subsamples for a two – tailed test having 95 % Significance level. We found that for independent variables Ease of learning ($\beta = 0.057$, confidence interval (0.5, 0.76)), Student's expectation ($\beta = 0.173$, confidence interval (0.024, 0.327)), Student's Satisfaction ($\beta = 0.73$, confidence interval (0.575, 0.914)) and, p-values were less than the critical level of 0.05 ($p < 0.05$) (Table 10). We concluded that the Independent Variables Ease of learning, Student's Expectation and Student's Satisfaction has positive effect on the academic performance. For Independent variable Student's expectation ($\beta = 0.366$, confidence interval (0.217, 0.548)) p value was also less than the critical value of 0.05 ($p < 0.05$) (Table 10) and thus the Student's Expectation has positive impact on Students Satisfaction. For all the other path of independent variables the p-value was above the critical level 0.05 and hence were significant and therefore has no positive impact on the dependent variables Student' Satisfaction and Academic performance of the learner.

The Total effects and the specific indirect effects for the bootstrapping results was also measured. According to the results Ease of learning and Student's expectations had positive effect on Students satisfaction; Student's expectations and Student's Satisfaction had positive effect on the Academic Performance of the learners ($p < 0.05$) (Table 11).

For the Specific Indirect Effects Students Satisfaction acts as mediating variable for the relationship between Ease of Learning and Academic Performance and also for Course material and Academic performance since the p-value for both the indirect path is less than the critical value of 0.05. ($p < 0.05$) (Table 12). The $R^2$ values of the previous studies were 0.67 (Ram Gopal Singh, Varsha Singh and Arun Aggarwal (2021) and 0.78 Rd. Nazim Xiomara (2021). So, the $R^2$ value of our model (0.871) is within the acceptable limits. (Table 13).

**Table 10: Bootstrapping results**

| Path | | Confidence Interval | P Values | Hypothesis | Hypothesis Supported | f2 |
|---|---|---|---|---|---|---|
| CM -> PERF | 0.057 | [-0.074,0.181] | 0.382 | *H1* | No | 0.007 |
| CM -> SS | 0 | [--0.144, 0.128] | 0.996 | *H2* | No | 0.000 |
| EOL -> PERF | -0.057 | [0.225, 0.085] | 0.470 | *H3* | No | 0.004 |
| EOL -> SS | 0.633 | [0.5, 0.76] | 0.000 | *H4* | Yes | 0.684 |
| EOU -> PERF | 0.022 | [-0.077,.0128] | 0.673 | *H5* | No | 0.002 |
| EOU -> SS | -0.023 | [-0.131,0.08] | 0.666 | *H6* | No | 0.001 |
| FT -> PERF | 0.061 | [-0.035,0.162] | 0.229 | *H7* | No | 0.009 |
| FT -> SS | -0.031 | [-0.15,0.084] | 0.601 | *H8* | No | 0.002 |
| SE -> PERF | 0.173 | [0.024,0.327] | 0.022 | *H9* | Yes | 0.050 |
| SE -> SS | 0.366 | [0.217, 0.548] | 0.000 | *H10* | Yes | 0.206 |
| SS -> PERF | 0.73 | [0.575, 0.914] | 0.000 | *H11* | Yes | 0.713 |

**Source: Own Calculations**

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**Table 11: Total Effects**

| Path | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (\|O/STDEV\|) | p- Values |
|---|---|---|---|---|---|
| CM -> PERF | 0.057 | 0.053 | 0.072 | 0.786 | 0.432 |
| CM -> SS | 0 | -0.003 | 0.07 | 0.005 | 0.996 |
| EOL -> PERF | 0.405 | 0.404 | 0.066 | 6.156 | 0.000 |
| EOL -> SS | 0.633 | 0.631 | 0.066 | 9.552 | 0.000 |
| EOU -> PERF | 0.005 | 0.005 | 0.062 | 0.083 | 0.934 |
| EOU -> SS | -0.023 | -0.024 | 0.054 | 0.427 | 0.670 |
| FT -> PERF | 0.038 | 0.037 | 0.06 | 0.636 | 0.525 |
| FT -> SS | -0.031 | -0.033 | 0.06 | 0.519 | 0.604 |
| SE -> PERF | 0.44 | 0.446 | 0.083 | 5.326 | 0.000 |
| SE -> SS | 0.366 | 0.373 | 0.084 | 4.337 | 0.000 |
| SS -> PERF | 0.73 | 0.737 | 0.086 | 8.46 | 0.000 |
| | | | | | |

**Source: Own Calculations**

**Table 12: Specific Indirect Effects**

| Path | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (\|O/STDEV\|) | P Values |
|---|---|---|---|---|---|
| EOU -> SS -> PERF | -0.017 | -0.018 | 0.04 | 0.419 | 0.675 |
| FT -> SS -> PERF | -0.023 | -0.025 | 0.045 | 0.508 | 0.612 |
| SE -> SS -> PERF | 0.267 | 0.274 | 0.068 | 3.924 | 0.000 |
| EOL -> SS -> PERF | 0.462 | 0.466 | 0.078 | 5.962 | 0.000 |
| CM -> SS -> PERF | 0.000 | -0.001 | 0.052 | 0.005 | 0.996 |
| | | | | | |

**Source: Own Calculations**

**Table 13: R-Square Value**

| Dependent Variable | | | R Square |
|---|---|---|---|
| Academic Performance | | | 0.871 |
| Student's Satisfaction | | | 0.828 |

**Source: Own Calculations**

**PLS Predict Assessment**

To test the Out of Sample Predictive Power of our model we followed the guidelines provided by Shumeli, Sarstedt et al., (2019). We calculated the Q2 Predict statistic and found the value of Q2 Predict > 0. We therefore assumed that the values have predictive power. The predictive power of the values was analyzed through PLS predict in Smart PLS. The PLS Predict values were analyzed in SPSS for the Normality test using Kolmogorov – Smirnova test. The p values for all the indicators was less than 0.5 so we used MAE values for all the indicators (Table 14). The MAE values of the PLS model were less than the MAE values of the linear model for few indicators (Table 15 ) .We assumed that our model have small to medium predictive power to predict the Academic Performance of the learner with Student's Satisfaction as a mediating variable.

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**Table 14: Tests of Normality For Dependent Variables using Kolmogorov-Smirnova Test**

| Construct | Indicator | Statistic | Sig. |
|---|---|---|---|
| Academic Performance | P1 | 0.063 | 0.000 |
| | P2 | 0.083 | 0.000 |
| | P3 | 0.068 | 0.000 |
| | P4 | 0.090 | 0.000 |
| Student's Satisfaction | SS1 | 0.078 | 0.000 |
| | SS3 | 0.054 | 0.000 |
| | SS4 | 0.074 | 0.000 |
| | SS2 | 0.07 | 0.000 |
| a Lilliefors Significance Correction | | | |
| | | | |

**Source : Own Calculations**

**Table 15 : PLS_Predict Assessment Model**

| | | PLS | | | LM | | PLS-LM |
|---|---|---|---|---|---|---|---|
| **Construct** | **Indicator** | **MAE** | **$Q^2$_predict** | | **MAE** | **$Q^2$_predict** | **MAE** |
| Academic Performance | P3 | 0.692 | 0.484 | | 0.701 | 0.476 | -0.009 |
| | P1 | 0.539 | 0.619 | | 0.544 | 0.613 | -0.005 |
| | P4 | 0.614 | 0.532 | | 0.6 | 0.527 | 0.014 |
| | P2 | 0.682 | 0.486 | | 0.678 | 0.493 | 0.004 |
| Student's Satisfaction | SS3 | 0.554 | 0.610 | | 0.546 | 0.615 | 0.008 |
| | SS1 | 0.55 | 0.605 | | 0.551 | 0.602 | -0.001 |
| | SS2 | 0.624 | 0.560 | | 0.621 | 0.566 | 0.003 |
| | SS4 | 0.572 | 0.635 | | 0.565 | 0.643 | 0.007 |
| | | | | | | | |

**Source : Own Calculations**

**Importance – Performance Analysis (IMPA)**

The importance – Performance analysis was conducted to analyze the performance and importance of the variables . The X -axis represented the perceived importance ( unimportant to very important) whereas the Y-axis represented the perceived performance ( low performance to high performance ) Martilla an James (1977) and Hair ,et al.,(2019). IPMA in fig 2 consists of Four Quadrants: Q1 (Important Variable and Performance is excellent), Q2 (Unimportant Variable and Performance is Excellent), Q3 (Important Variable and Performance is poor) and Q4 (Unimportant Variable and Performance is poor). We ran the IPMA analysis is Smart PLS and found that Student's Expectation, Ease of Learning and Satisfaction are important variable and the performance is excellent whereas Ease of Use, Course material and Faculty teaching were important but the performance was poor.

**Table 16: IMPA**

| Indicator | Importance | Performances |
|---|---|---|
| CM | 0.113 | 73.452 |
| EOL | 0.375 | 58.065 |
| EOU | 0.048 | 74.343 |
| FT | 0.083 | 71.321 |
| SE | 0.319 | 67.166 |
| SS | 0.578 | 60.751 |
| | | |

**Source: Own Calculations**

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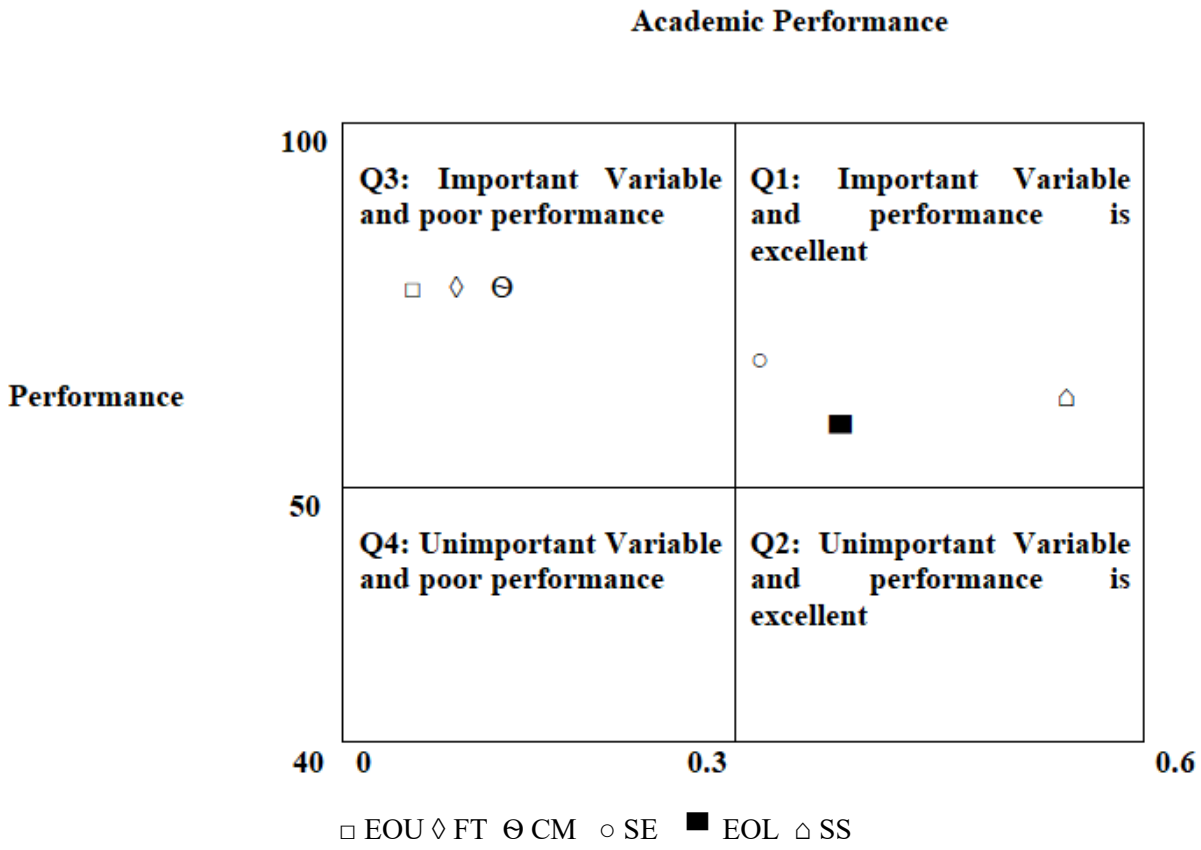
**Fig 2: IMPA Analysis**




**Necessary Condition Analysis**

The critical levels for Student's Satisfaction and Academic performance of the students were measured by conducting the Necessary Condition Analysis. The results of NCA analysis indicated that constructs Course material, Ease of Use, Faculty teaching and Student's expectation are both necessary and sufficient conditions for Student's Satisfaction effect size

($d \geq 0.1$) and ($p < 0.05$) whereas the Ease of Learning Construct is sufficient but not a necessary condition since effect size ($d < 0.1$) (Table 17). Similarly for Academic Performance of the student's Course material, Ease of Use, Faculty Teaching and Student's Expectations are necessary and sufficient condition effect size ($d \geq 0.1$) and ($p < 0.05$) and student's satisfaction and ease of learning are sufficient but not necessary conditions ($d < 0.1$) (Table 18).

We also found out the critical level required for Student's Satisfaction and the Academic Performance of the students through the NCA analysis. These levels are indicated in (Table 19) and (Table 20). To obtain a critical level of 70 % for Students Satisfaction the critical levels of course material , ease of use, ease of learning ,faculty teaching and student's expectations must be 6.9 % , 12.6 % , 33.5 % , 19.3 % and 35 % respectively and for critical level of 70 % for Academic Performance of the student's the critical levels of Student's Satisfaction , course material , ease of use, ease of learning ,faculty teaching and student's expectations must be 12.3 % , 16.5 % , 6 % ,27.2 % , 19.3 % and 32.9 % respectively .

**Table 17: NCA Effect Sizes: Student's Satisfaction**

| Indicator | cr_fdh | p-value |
|---|---|---|
| CM | 0.146 | 0.000 |
| EOL | 0.095 | 0.000 |
| EOU | 0.167 | 0.000 |
| FT | 0.142 | 0.000 |
| SE | 0.204 | 0.000 |
| | | |

**Source: Own Calculations**

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**Table 18: NCA Effect Sizes: Academic Performance**

| Indicator | cr_fdh | p-value |
|---|---|---|
| SS | 0.081 | 0.000 |
| CM | 0.111 | 0.000 |
| EOL | 0.075 | 0.000 |
| EOU | 0.110 | 0.000 |
| FT | 0.179 | 0.000 |
| SE | 0.146 | 0.000 |

**Source: Own Calculations**

**Table 19: Bottlenecks: Student's Satisfaction**

| SS | CM | EOL | EOU | FT | SE |
|---|---|---|---|---|---|
| 0 | NN | NN | NN | NN | NN |
| 10 | NN | NN | NN | 12.4 | NN |
| 20 | NN | NN | NN | 12.4 | 15.8 |
| 30 | NN | NN | NN | 12.4 | 17.5 |
| 40 | NN | NN | NN | 19.3 | 23.6 |
| 50 | NN | NN | NN | 19.3 | 23.6 |
| 60 | 16.9 | NN | 33.5 | 19.3 | 35 |
| 70 | 16.9 | 12.6 | 33.5 | 19.3 | 35 |
| 80 | 16.9 | 12.6 | 46.2 | 19.3 | 35 |
| 90 | 66 | 43.6 | 53.3 | 19.3 | 35 |
| 100 | 66 | 43.6 | 53.3 | 19.3 | 35 |
| | | | | | |

**Source: Own Calculations**

**Table 20: Bottlenecks: Academic Performance**

| PERF | SS | CM | EOL | EOU | FT | SE |
|---|---|---|---|---|---|---|
| 0 | NN | NN | NN | NN | NN | NN |
| 10 | NN | NN | NN | NN | 11.7 | NN |
| 20 | NN | NN | NN | NN | 11.7 | NN |
| 30 | NN | 16.5 | NN | NN | 12.4 | NN |
| 40 | NN | 16.5 | NN | NN | 12.4 | NN |
| 50 | NN | 16.5 | NN | NN | 12.4 | 17.5 |
| 60 | NN | 16.5 | 6 | 27.2 | 19.3 | 32.9 |
| 70 | 12.3 | 16.5 | 6 | 27.2 | 19.3 | 32.9 |
| 80 | 25.3 | 16.9 | 25 | 27.2 | 32.2 | 35 |
| 90 | 44.4 | 16.9 | 31 | 33.5 | 36.5 | 35 |
| 100 | 44.4 | 50.1 | 43.6 | 54.3 | 36.5 | 35 |
| | | | | | | |

**Source: Own Calculations**

**Contribution**

Our study has contributed that the student's satisfaction act as important mediating variable for the improving the academic performance of the ungraduated learners. We also found that the students' expectation about e-learning had positive impact on both the student's satisfaction and academic performance.

Our Proposed PLS-Predict model has a medium predictive power for analyzing the effect of independent variables like Course of material, Ease of Use, Ease of learning, Faculty teaching and Student's Expectation with Student's satisfaction as a mediating variable on the Academic Performance of the students.

Very few studies have analyzed the combined effect of PLS-SEM and NCA analysis. Through the combined analysis we found that Course of material, Ease of Use, Ease of learning, Faculty teaching and Student's

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Expectation are necessary and sufficient factors for the Academic Performance of the learners. We also found out the critical level of independent variables required for the having 70 % ,80 %, 90 % and 100 % Student's satisfaction and Academic performance through bottleneck analysis.

We also found the important and performing variables for improving the academic performance of the learners through IMPA analysis. Student's Expectation, Ease of Learning and Satisfaction are important and performing variables whereas Ease of Use, Course material and Faculty teaching were important but were not performing.

**FURTHER SCOPE OF THE STUDIES:**

Our study has many limitations. The study was confined to the primary data collected from the undergraduate learners of University of Mumbai. The sample size of the research studies was 627. Future studies of Online learning can be conducted through Multigroup analysis at All India level with a large sample size and anchor based measurement of Independent variables and dependent variables instead of attribute measurement.

**CONCLUSION**

The independent factors course material, ease of use, ease of learning, faculty teaching, student's perception are necessary and sufficient factors for predicting the effect on the academic performance of the learners. Course material should be updated and made easy and also the ease of use of the Online learning platforms for improving the Academic performance of the learners. The faculty teaching for Online learning has to be improved to have a positive and significant effect on the academic performance of the learners.

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