Examination of Study Skills, Emotions, Engagement, and Academic Performance of Mechanical Engineering Students of CIT-University Taking Online Courses: Bases for Student and Faculty Development Program

*Angelo A. Acenas**, *Shiela Marie B. Alia, Ronnel T. Lucero*
Department of Mechanical Engineering, Cebu Institute of Technology University, Cebu City, Philippines
*angeloacenas@gmail.com

ABSTRACT

Amidst the disruptive backdrop of the pandemic, faculty members are required to exhibit heightened awareness and adaptability in response to the challenges posed by the evolving academic landscape. Concurrently, students are tasked with cultivating resilience to effectively navigate their educational pursuits. To bolster the capacities of both faculty and students, a comprehensive exploration of various factors becomes imperative to grasp the intricacies of academic performance within the framework of online distance learning for undergraduate mechanical engineering courses. Scholarly literature suggests that academic performance is influenced by study skills, emotional well-being, and levels of engagement. By employing the revised Online Student Engagement Scale survey, data gathered from 243 students underwent meticulous analysis through Spearman rank-order correlation. This scrutiny unveiled a robust and affirmative correlation between students' study skills, emotional states, engagement levels, and academic accomplishments. Significantly, among these factors, student engagement emerged as the most influential predictor of elevated academic achievement. The research outcomes culminate in the formulation of a strategic intervention strategy. This strategy aims to augment the adeptness of both educators and learners in effectively navigating the realm of online learning. In conclusion, the upheaval caused by the pandemic underscores the urgency for faculty and students to adapt. Through an in-depth investigation, this study underscores the pivotal role of student engagement, alongside study skills and emotional well-being, in determining academic success. These insights guide the formulation of a targeted plan of action, poised to enhance the competence of both stakeholders in embracing the demands of online education.

Keywords: *Online class, student engagement, emotional well-being, academic performance, study skills*

Introduction

The COVID-19 pandemic has profoundly impacted various industries, including the higher education sector. In response to the "new normal," the higher education sector has undergone significant adaptations. The imperative to deliver quality outcomes-based education in an online format has compelled educators to explore innovative and effective methodologies for conducting virtual classes. Both educators and students have faced considerable challenges due to this transition to online higher education delivery.

Cebu Institute of Technology – University (CIT-University) is committed to upholding its commitment to delivering quality outcomes-based education despite the formidable challenges presented by the current circumstances. The university is determined to foster innovation and adjust to the new normal by introducing online services that maintain a high standard of service for administration, faculty, and students. In this context, the university has established the MADE4Learners framework to address the unique needs of students and instructors. To this end, CIT-University has adopted various approaches, including the online approach, online-blended approach, and distance-blended approach. Recognizing the importance of addressing students' emotional well-being, the university has initiated webinars and consultations through its guidance and counselling office. Moreover, to enhance students' study skills, the university has made the e-library and other online learning resources accessible. To encourage active participation in virtual classes, CIT-University has implemented a suite of tools, including the Moodle learning management system, video conferencing, and messaging tools such as MS Teams. However, despite these efforts, there remains a gap in understanding the impact of these interventions on students' academic performance.

Aligned with the University Research Agenda under Research and Development (R&D) for teaching and learning, faculty members have been encouraged to pursue research endeavours aimed at innovating and refining the online-distance learning setup to facilitate more effective and convenient learning experiences.

The overarching objective of the Department of Mechanical Engineering at CIT-University is to produce graduates who are not only skilled practitioners in their field but are also equipped for further graduate studies and research work. These graduates are expected to meet both local and global demands while upholding the ethical standards of their profession and fulfilling their responsibilities within the community. Given the unprecedented circumstances, the department is compelled to examine the factors influencing students' performance in online classes.

The outcomes of this investigation are intended to bolster the capabilities of both students and teachers in navigating the realm of online learning.

Considering the above, this study has developed a comprehensive faculty and student development program. The initial assessment phase of this program sought to address the following key inquiries:

1. What is the correlation between students' study skills and their academic performance?
2. To what extent does students' emotional well-being during online classes correlate with their academic performance?
3. What relationship exists between students' engagement levels in online classes and their academic performance?
4. Based on the findings, what actionable recommendations can be proposed to enhance the capacity of both students and teachers in the context of online learning?

Review of Related Literature

Online Class Study Skills and Performance

The online learning environment necessitates an exploration of the relationship between a learner's skills and their performance. Despite a general adjustment to the new normal, individual skill sets vary among students, as does the instructional approach of educators. These variations can yield differing outcomes compared to traditional face-to-face classes. Thurmond (2002) highlighted that student satisfaction with a university Web-based course was primarily influenced by the online classroom environment rather than the students' personalities.

Online Class Students' Emotion

Zembylas (2008) delved into the impact of learner emotions on performance within an online class. This study traced how emotions evolved throughout a year-long online-distance learning course. Novice adult learners displayed varying emotional responses to online learning, with openness and emotional expression becoming more evident as the course progressed. The study noted that emotions were influenced by factors such as gender roles, responsibilities, and the evolving demands of the online learning environment. Positive emotional responses included enthusiasm and excitement due to the flexibility of online learning, though fear and anxiety stemming from unfamiliarity with online methodologies were also reported. Feelings of alienation and a desire for connectedness were also prevalent, reflecting the students' recognition of their compatibility (or lack thereof) with the online setup. D'Errico et al. (2016) observed that students generally experienced higher levels of positive emotion compared to negative emotion during online classes, particularly synchronous sessions that allowed interaction with peers and instructors. The study also revealed that positive emotions during exam preparation were associated with better exam performance. Furthermore, Walton et al. (2020) established a strong association between social and emotional skills, learning management system (LMS) data, and grades.

Online Class Attendance and Participation

In the online context, a student's participation and attendance define their class performance. Despite the advantages and disadvantages of online learning, active participation remains a key expectation. Oser et al. (2008) highlighted distinct differences between online and offline class participation patterns, with stratification patterns varying due to factors such as income, age, gender, and socio-demographic variables. Caspi et al. (2006) underscored that gender differences also influence performance, with males tending to contribute more in face-to-face classes while females engaged more in online discussions. Khalili et al. (2018) proposed using online interaction or feedback platforms to enhance class participation, finding that adjusting instructional dynamics according to student needs and learning styles was essential. Furthermore, student engagement with the online instructor emerged as a critical factor for successful online learning, as noted by Fredericksen et al. (2000) and Jung et al. (2002) cited in Yeboah et al. (2016).

Methodology

The researchers employed the descriptive-correlational research method for the execution of this study, utilizing survey data collected from students. The survey was designed by adapting the Online Student Engagement Scale (Dixson, 2010) to suit the specific context of the investigation.

The study's participant pool comprised 243 students enrolled in the BS Mechanical Engineering program at Cebu Institute of Technology University during the 2020-2021 academic year. These students were specifically enrolled in online mechanical engineering major courses. The survey was administered using Microsoft Forms as the online survey platform. The gathered data was subsequently compiled, analyzed, and interpreted utilizing the Statistical Package for Social Sciences (SPSS).

Results and Discussion

The data collected from the online survey was organized to answer the following questions: What correlation exists between students’ study skills and class performance? What correlation exists between students’ online class emotional

well-being and class performance? What correlation exists between students' online class engagement and class performance? With the findings, what plan of action may be proposed to enhance the capacity of both students and teachers in handling online learning?

The result of the demographic profiling of the respondents showed that there were 81% Male and 19% Female, 79% BSME Computational Science Track and 21% BSME Mechatronics Track, 6% fifth year, 38% fourth year, 33% third year, 20% second year, and 2% first-year students.

Table 1 provides an overview of the mean, standard deviation, description, and rank for each study skills-related statement. Statement A1 received the highest mean score, indicating a strong level of agreement among participants. On the other hand, statements A3, A5, and A4 obtained comparatively lower mean scores. This suggests that students are dedicated to allocating personal study time and actively participating in classes, yet there is room for improvement in terms of organizational skills and note-taking practices. Considering these findings, an instructional approach like flipped instruction could be adopted by educators. Flipped instruction involves reversing traditional notions of classroom activities and homework. Notably, the study conducted by Nouri (2016) unveiled that many students displayed a positive response to flipped instruction, manifesting in heightened motivation, increased engagement, and enhanced learning outcomes. This pedagogical approach may prove beneficial in further enhancing students' study skills and overall academic performance.

Table 1: Factors affecting academic performance related to study skills

Statements	Mean	Standard Deviation	Description	Rank
A1. I make sure to allocate personal study hours for ME major subjects on a regular basis.	3.93	0.73	Moderately true	1
A2. I am actively engaged with the reading materials of ME major subjects.	3.79	0.74	Moderately true	3
A3. I review ME major subject class notes before attending synchronous classes for better understanding of the study material.	3.75	0.84	Moderately true	4
A4. I am organized when it comes to ME major subjects.	3.79	0.74	Moderately true	3
A5. I take comprehensive notes during readings, PowerPoints, or video lectures of ME major subjects.	3.75	0.84	Moderately true	4
A6. I listen and read attentively during ME major classes.	3.82	0.81	Moderately true	2

The research results from Table 2 provide insights into the correlation between emotions and academic performance, shedding light on how emotional factors influence students' performance in their ME major subjects. The statements within the table represent various aspects of students' emotional involvement with the material and their desire to learn.

Table 2: Factors affecting academic performance related to emotions

Statements	Mean	Standard Deviation	Description	Rank
B1. I put forth effort in ME major subjects.	3.75	0.84	Moderately true	3
B2. I find ways to make ME major subject's study material relevant to my life.	3.82	0.81	Moderately true	1
B3. I apply ME major subject's study material to my life.	3.79	0.91	Moderately true	2
B4. I find ways to make the ME major subjects interesting to me.	3.82	0.81	Moderately true	1
B5. I really desire to learn the ME major subject study material.	3.79	0.91	Moderately true	2

Statements B1, B2, and B3 reflect students' effort, application, and relevance of the study material to their lives. Students moderately agreed that they put forth effort in their ME major subjects (B1), indicating a positive level of commitment. The fact that they find ways to make the study material relevant to their lives (B2) and apply it (B3) highlights their intention to connect their academic pursuits to practical applications. On the other hand, statements B4 and B5 delve into students' interest and desire to learn the subject material. Students indicated moderate agreement with

finding ways to make the ME major subjects interesting (B4) and expressing a genuine desire to learn the study material (B5). This suggests that students actively seek ways to engage with the content and are motivated by personal interest.

Building upon the findings presented, it is worth noting the work of D'Errico et al. (2016), which highlights a strong correlation between positive emotions during exam preparation and students' motivation. This correlation directly supports the learning process and the resulting outcomes. To leverage these insights and enhance students' learning outcomes through targeted positive motivation and emotion, educators can implement strategies that align with the research findings.

Table 3 presents the result on the role of engagement in relation to academic performance. The results indicate the level of agreement with statements regarding different aspects of engagement within the online learning environment.

Table 3: Factors affecting academic performance related to engagement

Statements	Mean	Standard Deviation	Description	Rank
C1. I have enjoyable interactions in online chats, discussions, or emails with instructors or peers in ME major subjects.	3.98	0.75	Moderately true	2
C2. I actively participate in small-group discussion forums in ME major subjects.	3.79	0.91	Moderately true	3
C3. I assist fellow students in ME major subjects.	3.98	0.75	Moderately true	2
C4. I engage in online conversations (chat, discussions, email) related to ME major subjects.	4.19	0.68	Moderately true	1
C5. I regularly contribute to discussion forums about ME major subjects.	3.98	0.75	Moderately true	2
C6. I establish connections with other students in the ME major class.	4.19	0.68	Moderately true	1

In terms of student engagement, the data collected from BSME students at CIT University enrolled in ME major courses through online classes revealed a moderately positive response across all engagement-related statements. Notably, the two statements C4 and C6 garnered the highest mean scores, indicating a significant level of involvement and interaction within the larger class setting. Conversely, the statement C2 obtained the lowest mean score, suggesting a relatively lower engagement level in this specific activity. This finding highlights a potential gap in active participation within smaller group settings, which is crucial for fostering meaningful peer interactions and collaborative learning experiences.

Drawing insights from the works of Jung et al. (2002) as cited in Yeboah et al. (2016), it is evident that active cooperation among co-learners contributes to increased satisfaction, improved social interactions with instructors, and enhanced overall class learning. The emphasis on interactions with fellow students is underscored as a significant driver of effective online learning.

To address the observed gap in engagement within small-group discussion forums, several strategies can be employed. For instance, instructors can stimulate student engagement during synchronous classes by posing thought-provoking questions that encourage students to share their insights using the chat feature of video conferencing platforms. Additionally, the integration of focused group discussions and break-out rooms at the conclusion of synchronous sessions can provide opportunities for students to engage in in-depth, small-group interactions, enabling them to exchange takeaways from the lesson, ask questions, and enrich their understanding collaboratively.

Moreover, it is advisable for instructors to periodically assess students' experiences within small groups compared to larger class settings. This evaluation can offer valuable insights into the effectiveness of engagement strategies and provide a platform for making targeted improvements to enhance the overall learning experience.

The findings from Table 4 reveal how students perceive their academic performance within the context of ME major subjects. Statement D2 received the highest mean score of 4.19, indicating strong agreement among students. This suggests that students feel confident about their performance in assessments and quizzes within the ME major subjects. It is notable that this statement also holds the top rank, emphasizing its significance.

Table 4: Academic performance as perceived by the students

Statements	Mean	Standard Deviation	Description	Rank
D1. I am getting good grades in ME major subjects.	4.06	0.83	Moderately true	2
D2. I am doing well on the tests/quizzes of ME major subjects.	4.19	0.68	Moderately true	1

Statement D1 received a mean score of 4.06 and holds the second rank. While this mean score is slightly lower than that of D2, it still signifies a high level of agreement among students. This result underscores students' perception of achieving satisfactory grades in their ME major subjects. The relatively small standard deviations for both statements (0.83 and 0.68) suggest that there is a certain level of consistency among student responses, indicating that their perception of their academic performance is relatively uniform.

To create a more valid inference from the data above, statistical analysis was done using the Statistical Package for Social Sciences (SPSS). The result is presented in Table 5.

Table 5: Kolmogorov-Smirnov Normality Test using SPSS Statistic

Variables	p-value	Decision
Performance	< 0.001	Reject null hypothesis
Study Skills	< 0.001	Reject null hypothesis
Emotions	< 0.001	Reject null hypothesis
Engagement	< 0.001	Reject null hypothesis

Based on Table 5, the probability value is less than 0.05 for all the variables which is a valid basis for rejecting the null hypothesis that the data are normal. Hence, we accept the alternative hypothesis that the data are not normal. For not normally distributed Likert scale data, we shall use non-parametric method of data analysis such as ordinal, multinomial logistic regression analysis, and the Spearman rank correlation.

Using ordinal logistic regression test of parallel lines, Table 6 shows that the probability value is less than 0.05. This means that the assumption of proportional odds is violated. Thus, a traditional cumulative logistic regression needs to be used instead. A multinomial logistic regression is then used to determine the predictor of student performance among the three variables.

Table 6: Ordinal Logistic Regression Test of Parallel Lines using SPSS Statistic

Model	-2 Log Likelihood	Ch-square	df	p-value	Decision
Null hypothesis	669.9				
General	625.5	44.4	21	< 0.002	Reject null hypothesis

The “Final” row in Table 7 presents information on whether all the coefficients of the model are zero. Another way to consider this result is whether the variables you added statistically significantly improve the model compared to the intercept alone. Since the probability value ($p < 0.001$) is less than 0.05, then the full model statistically significantly predicts the dependent variable better than the intercept-only model alone.

Table 7: Multinomial Logistic Regression Fitting Information Using SPSS Statistic

Model	-2 Log Likelihood	Ch-square	df	p-value	Decision
Intercept only	808.2				
General	641.2	166.9	24	< 0.001	Reject null hypothesis

Table 8 shows which of the independent variables are statistically significant predictors of a student’s academic performance. The emotional factor was not statistically significant ($p = 0.346$) while the study skill factor was statistically significant ($p = 0.008$) along with engagement ($p < 0.001$). These results contain the overall contribution of each independent variable to the model. Using the alpha = 0.05 threshold, we see that students’ study skills and engagement are significant predictor of their academic performance.

Table 8: Multinomial Logistic Regression Likelihood Ratio Test Using SPSS

Effect	Chi-square	df	p-value	Decision
Intercept	96.776	8	< 0.001	Reject null hypothesis
Study Skills	20.555	8	< 0.008	Reject null hypothesis
Emotions	8.955	8	< 0.346	Accept null hypothesis
Engagement	54.539	8	< 0.001	Reject null hypothesis

Another method to determine the effects of each variable on student performance is the use of Generalized Linear Model. Table 9 shows the GLM’s parameter estimates. The odd ratio indicates statistically significant result that the odds of being in a higher level on the student performance increases by a factor of 5.086 ($p < 0.001$) for each one

unit increase on the student engagement and a factor of 2.357 (p = 0.012) for each one unit increase in study skills. Emotions on the other hand have no statistically significant result.

Table 9: Generalized Linear Model Parameter Estimates Using SPSS

Effect	Wald Chi-square	df	p-value	Odd ratio	Decision
Study Skills	6.455	1	0.012	2.357	Reject null hypothesis
Emotions	1.535	1	0.215	1.408	Accept null hypothesis
Engagement	43.053	1	< 0.001	5.086	Reject null hypothesis

Since the data are non-parametric, a Spearman's rank-order correlation was run to determine the relationship between 243 students' study skills, emotions, and engagement to student's academic performance as shown in Table 10. There was a strong, positive correlation between study skills and student's performance, which was statistically significant ($r = 0.493$, $p < 0.001$), between emotions and student's performance, which was statistically significant ($r = 0.441$, $p < 0.001$), and between engagement and student's performance, which was statistically significant ($r = 0.629$, $p < 0.001$). The strongest among the variables is student engagement.

Table 10: Spearman's Rank-Order Correlation using SPSS Statistics

Parameter	Spearman's rho	p-value	Decision
Study Skills	0.493	< 0.001	Reject null hypothesis
Emotions	0.441	< 0.001	Reject null hypothesis
Engagement	0.629	< 0.001	Reject null hypothesis

Conclusion

Based on the insights drawn from the analysis of 243 students enrolled in BS Mechanical Engineering major subjects within the online class setting at Cebu Institute of Technology University, a compelling connection emerges. The data unequivocally underscores a robust positive correlation between students' study skills, emotional disposition, engagement levels, and their subsequent academic performance. Notably, among these three critical facets, student engagement emerges as the most potent predictor, carrying the strongest influence over achieving commendable academic outcomes.

These findings hold significant implications for enhancing the academic journey of these students. To fortify academic performance, it is recommended that educators embark on a journey of self-improvement. This entails equipping teachers with targeted training sessions that encompass a spectrum of themes. These themes, while not confined to, encompass topics such as implementing flipped instruction techniques, harnessing experiential and active learning strategies, adeptly formulating attainable learning goals and outcomes, and cultivating an environment conducive to collaborative small group learning dynamics.

Contributions of Authors

The authors confirm the equal contribution in each part of this work. All authors reviewed and approved the final version of this work.

Funding

This work received no specific grant from any funding agency.

Conflict of Interests

All authors declare that they have no conflicts of interest

Acknowledgment

We would like to thank our research advisory board for the assistance in making this research.

References

Albrahim, F. A. (2020). Online Teaching Skills and Competencies. TOJET: *The Turkish Online Journal of Educational Technology*. (January 2020, Volume 19 (Issue 1)

Caspi, A., Chajut, E., Saporta, K. (2006). Participation in class and in online discussions: Gender Differences. *Computers and Education* 50 (2008) 718-724

D'Errico, F., Paciello, M., and Cerniglia, L. (2016). When emotions enhance students' engagement in e-learning processes. *J. ELearn. Knowl. Soc.* 12, 9–23. doi: 10.20368/1971-8829/1144

Dixson, M.D., (2010). Creating effective student engagement in online courses: What do students find engaging? *Journal of the Scholarship of Teaching and Learning*, Vol. 10, No. 2, June 2010

Khalili, M., Ostafichuk, P. M. (2018). Improving Class Participation by using an Online Interactive Platform. *Canadian Engineering Education Association* (CEEA-ACEG18) Conference. University of British Columbia,Paper 15

Nouri, J. (2016). The flipped classroom: for active, effective and increased learning – especially for low achievers. *International Journal of Educational Technology in Higher Education* volume 13, Article number: 33 (2016)

Oser, J., Hooghe, M., Marien, S., (2013). Is Online Participation Distinct from Offline Participation? A Latent Class Analysis of Participation Types and Their Stratification. *Political Research Quarterly*, 66, Sage Publications. Thousand Oaks 2013 (Imp.F.1.1018:5yr:1.249)

Thurmond, V. A., Wambach, K., Connors, H. R., & Frey, B. B. (2002). Evaluation of student satisfaction: Determining the impact of a Web-based environment by controlling for student characteristics. *The American Journal of Distance Education*

Trudeau, C. S. (2018). A Campus Model for Student Development: Program Review and Prioritization. Growth: *The Journal of the Association for Christians in Student Development*, volume 17 (issue17), Article 2

Walton, K.E., San Pedro, S., Whitmer, J., Liu, R., Moore, J.L., & Lotero, A.A. (2020). Using Feature Engineering from Online Learning Environments to Observe Social and Emotional Skills and Academic Performance. *ACT Research & Policy.*

Yeboah, A.K., Smith, P. (2016). Relationships between Minority Students Online Learning Experiences and Academic Performance. *Online Learning*, Volume 20 (Issue 4), December 2016

Zembylas, M. (2008). Adult Learner's Emotion in Online Learning. *Distance Education*, volume 29 (issue number 1).71-87.