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Assessing Google Classroom's Effectiveness in Communication Skills

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Abstract. This study delves into the effectiveness of Google Classroom in enhancing academic performance among first-year engineering students in a communication skills course. Rooted in the Technological Pedagogical Content Knowledge (TPACK) model and the Diffusion of Innovations theory, the research tests two hypotheses regarding the impacts of technology use and the instructor factor on student outcomes. With a sample of 356 students, the analysis employs t-tests and regression analysis to compare performance between students using Google Classroom and traditional teaching methods. The results reveal no significant difference in performance between the two groups, suggesting that integrating Google Classroom does not inherently enhance academic outcomes. However, marginal effects of instructor involvement were observed, underscoring the intricate interplay of human and technological factors in educational settings. The implications of these findings are significant, as they provide a nuanced understanding of the role of technology in education and the importance of effective instructor engagement. Future research should examine technology's role across diverse disciplines and the dynamics of instructor-student interactions within technology-enhanced environments.

Keywords. Engineering education, Google Classroom, performance, communication skills.

1. Introduction

Over the past few decades, educators, policymakers, and stakeholders have been increasingly concerned about incorporating information and communication technology (ICT) in education. While some argue that technology is a powerful tool that can revolutionize teaching and learning, enhancing engagement, accessibility, and overall educational outcomes [1], others caution against the overreliance on technology, emphasizing the potential drawbacks such as distractions, the digital divide, and the erosion of essential interpersonal skills [2].

Although well-designed educational technology tools can enhance student engagement and improve learning outcomes, effective technology implementation into the educational system still needs to meet expectations [3]. As educators, policymakers, and parents struggle with these contrasting perspectives, the question looms large: To what extent should technology be woven into the education fabric?

The advocates for technology in education assert that its incorporation brings a paradigm shift, transforming traditional classrooms into dynamic, interactive learning environments. The rise of digital tools, educational apps, and online resources has provided educators with innovative ways to cater to diverse learning styles, fostering a more personalized and inclusive approach to teaching. Research from the International Journal of Educational Technology in Higher Education emphasizes the potential of technology to facilitate customized learning experiences catering to individual student needs [1]. Moreover, technology proponents argue that it bridges geographical gaps, enabling students to access educational materials and expertise from virtually anywhere. With the advent of online courses and virtual classrooms, students are no longer bound by the constraints of physical classrooms, opening avenues for remote learning and collaboration. This newfound accessibility has the potential to democratize education, breaking down barriers for those who might otherwise face challenges in attending traditional institutions.

Despite these promising benefits, critics raise concerns about the potential pitfalls of integrating technology into education. One recurring argument revolves around the distraction factor: the allure of smartphones, tablets, and laptops can lead to losing focus and diminished attention spans [2]. The tools designed to enhance learning can inadvertently become sources of diversion, diverting students' attention away from the educational content at hand. Proponents of this attitude argue that, if not properly managed, the influx of technology may result in a generation of students more adept at navigating digital interfaces than mastering critical thinking skills. Another compelling argument against technology in education is the digital divide. While technology-rich environments may be the norm in affluent schools, many underserved communities lack access to the necessary devices and high-speed internet, exacerbating existing disparities.

In the realm of higher education, research has primarily focused on the positive role played by technology. For instance, Johnson et al. [4] explored the potential of adaptive learning technologies to tailor educational experiences to individual student needs. Altbach et al. [5] delved into the role of technology in globalizing higher education and increasing access for students worldwide. These studies underscore the positive impacts of technology on higher education, including improved learning outcomes, personalized instruction, global access, enhanced collaboration, and innovative pedagogies. However, a crucial aspect that has yet to be thoroughly examined in higher education is the direct impact of technology on students' actual classroom performance.

Most of the research in this field has been conducted in K-12 settings. No research studies have specifically investigated the effect of using technological tools/platforms on engineering students' actual performance in courses offered at engineering faculties. This study aims to fill this gap by exploring the impact of such platforms on academic performance among engineering students.

2. Literature review

2.1. Comprehensive Impact of Technology in Education

A comprehensive review by Kalati and Kim [6] analyzed 53 studies and found that most reported positive effects of technology integration, particularly with touchscreen devices. However, the results were mixed, with a few studies noting negative impacts. This mixed evidence points to the complexity of technology's role in educational outcomes and highlights the need for detailed studies that consider specific technologies and academic contexts.

In higher education and specific disciplines such as engineering, more is needed about the effectiveness of platforms like Google Classroom, which integrates easily with existing digital infrastructures and supports streamlined communication and assignment management.

This study aims to fill this gap by examining Google Classroom’s impact on communication skills in engineering students, guided by the Technological Pedagogical Content Knowledge (TPACK) model and the Diffusion of Innovations theory. These frameworks suggest that the successful integration of technology in education depends on the technology itself and how it is pedagogically applied and adopted by instructors [7], [8].

2.2. *Google Classroom as an educational tool*

Google Classroom has become a pivotal tool in the evolving educational technology landscape. Google launched it on August 12, 2014, as part of its Google Apps for Education suite. Designed to facilitate a paperless learning environment, it simplifies creating, distributing, and grading assignments, enhancing communication and organizational efficiency between educators and students. This functionality has proven essential during the recent shift towards online learning, necessitated by the global pandemic, which emphasized the need for accessible educational resources beyond traditional classroom settings [9].

Google Classroom supports basic administrative tasks as a learning management system (LMS). It enhances pedagogical delivery through integrated feedback mechanisms that align with the Technological Pedagogical Content Knowledge (TPACK) model, underscoring the importance of aligning technological tools with pedagogical strategies and content knowledge to optimize learning outcomes. Such alignment suggests that effective use of Google Classroom can significantly impact educational practices, particularly in engineering education, where such alignment is crucial [10].

The platform was specifically developed to reduce the reliance on physical paper within educational settings, supporting a paperless environment. Initially tailored for educational laptops like Chromebooks, its functionality extends to streamlining information sharing and assignment organization between instructors and students. This capability has been particularly crucial during the recent pandemic, highlighting the need for accessible educational resources that transcend conventional classroom boundaries. The shift towards online learning across many educational institutions has led to the widespread adoption of Google Classroom, underscoring its role in promoting innovative educational practices and remote learning opportunities.

Google Classroom's integration into educational settings aligns seamlessly with the Technological Pedagogical Content Knowledge (TPACK) model, which emphasizes the importance of aligning technology with pedagogical strategies and content knowledge to enhance learning outcomes. By providing a platform that integrates seamlessly with existing educational tools, Google Classroom offers a practical example of technology educators can effectively adopt to meet diverse learning needs and circumstances [11], [12].

This literature underscores the need for our investigation into Google Classroom's specific impacts in an engineering education setting. It addresses the technological and instructor factors to explore their effects on student academic performance.

3. Theoretical framework

This study is framed within two critical educational theories examining technology's impact on academic outcomes: the Technological Pedagogical Content Knowledge (TPACK) model and the Diffusion of Innovations theory.

3.1. *Technological Pedagogical Content Knowledge (TPACK)*

The TPACK model [13] offers a comprehensive framework for understanding how teachers' understanding of technology integration is essential for effective teaching. This framework is particularly pertinent in analyzing how the use of Google Classroom might enhance or fail to enhance academic performance in engineering communication courses. According to TPACK, effective technology integration in education requires understanding the interplay among content, pedagogy, and technology. This model supports our investigation into whether technological tools such as Google Classroom can significantly enhance academic outcomes compared to conventional methods.

3.2. Diffusion of Innovations Theory

The Diffusion of Innovations theory [14] is utilized to understand how innovations, such as Google Classroom, are adopted within educational settings and how they impact student outcomes. This theory posits that the adoption and effectiveness of new technologies can vary greatly depending on several factors, including the innovativeness of adopters, which in this context translates to instructors' willingness and capability to integrate new technologies into their teaching practices. It underscores the significance of the instructor factor in educational outcomes, forming the basis for our second hypothesis concerning the role of instructor influence on student performance.

Aligned with the TPAK and the Diffusion of Innovations theory, this study formulates two key hypotheses:

Hypothesis 1 (H1): Engineering students using Google Classroom will perform better academically in communication skills courses than those not using the platform.

Hypothesis 2 (H2): The effect of using Google Classroom on students' academic performance will be moderated by the instructor factor, with more technologically adept instructors yielding better student performance outcomes.

This theoretical framework guides the study's empirical investigation and enriches the discussion of how technology and instructor factors interact to affect educational outcomes. Through this lens, the study aims to contribute to a clear understanding of the dynamics in technologically enhanced educational environments.

4. Methodology

4.1. Study Design

This study employs a quantitative research design to evaluate the impact of Google Classroom on first-year engineering students' academic performance in a communication skills course. The researcher compares the educational outcomes of students using Google Classroom with those using traditional teaching methods. Students were divided into two groups: the first group used Google Classroom for coursework, assignments, and communication, and the second group relied on traditional methods, including face-to-face interactions and physical handouts.

4.2. Participants

The study involved 356 first-year engineering students enrolled in a compulsory communication skills course designed to enhance their proficiency in English, focusing on both spoken and written skills. All participants shared similar educational backgrounds, providing a homogeneous sample for assessing the impact of instructional methods.

The students were distributed across 18 different sections, taught by ten instructors. Some instructors taught two sections and some others taught one. Five insturctors utilized Google Classroom as the primary teaching tool and the other five followed conventional teaching methods, relying on physical handouts and paper-based submissions. This dichotomy allowed for a comparative analysis of digital versus tradional pedagogical effectiveness. Each instructor independently decided whether to use Google Classroom or conventional methods.

4.3. Data Collection and Analysis

Performance metrics were gathered through final exam scores and continuous assessment grades, including project work and in-class activities. These data points provided a quantitative basis for evaluating academic achievement across different teaching modalities.

Statistical analyses, including t-tests and regression analysis, were conducted to determine the significance of differences between the two groups and the potential moderating effect of the instructor factor. These methods allowed us to rigorously test our hypotheses and draw meaningful conclusions about Google Classroom's impact on student performance.

4.4. Ethical Considerations

While the participating university does not have a formal Institutional Review Board, the study was conducted strictly with the ethical guidelines recommended for educational research. All data were handled with the utmost respect for participant privacy and security.

5. Findings

This study investigated the influence that using the Google Classroom platform might have on students' performance in communication skills classes offered by the faculty of engineering at a Middle Eastern university. It also investigated the role played by instructors. Table 1 below shows the average Mean of the final score of each group or section, the instructor’s name, and whether Google Classroom was used as a primary tool of instruction or not.

Table 1: Average Mean of the final score, instructor’s name, and Google Classroom use

Final score	Instructor	Google Classroom use
82.48	Instructor 1	No
76.38	Instructor 2	No
73.68	Instructor 3	Yes
76.1	Instructor 4	No
80.66	Instructor 5	Yes
75.82	Instructor 6	Yes
81.43	Instructor 7	Yes
69.02	Instructor 8	Yes
73.81	instructor 9	No
79.71	Instructor 10	No

The two-sample t-test results (table 2 below) comparing the mean scores of students in the Google Classroom group ($M = 76.32$) and the No Google Classroom group ($M = 77.87$) revealed no statistically significant difference in their academic performance. The variance within the Technology group was 131.18; within the No Technology group, it was 121.52. The t-statistic of -1.29 did not surpass the critical value of ±1.9667, and the p-value of 0.1982 exceeded the 0.05 significance level indicating that students enrolled in communication skills courses that use Google Classroom as a leading instructional platform will not significantly perform better than students enrolled in communication skills courses that do not use Google Classroom as a primary instructional tool.

Table 2: Testing for the difference between the two groups

	Mean	*SD*	Variance	t Test (df)	P value
Google Classroom	76.31	23.334	131.178	-1.288(354)	.0991
No Google Classroom	77.87		121.515		

The regression analysis was conducted to explore the impact of the Instructor Factor on students' academic performance (Table 3). The results indicate that the overall model, with an R-squared of 0.009, explains a small proportion of the variance in student performance. The ANOVA table suggests that the regression model is not statistically significant at the conventional 0.05 significance level (F = 3.18, p = 0.076). The coefficient for the instructor variable is -0.429, and its associated p-value is 0.076, approaching but not reaching conventional levels of significance; this suggests that there may be a marginal association between the Instructor Factor and student performance, but caution should be exercised in drawing definitive conclusions. The negative coefficient implies that, on average, as the Instructor Factor increases, there is a slight decrease in student performance. However, given the borderline significance and the small effect size, further investigation and consideration of additional factors may be needed to gain a more in-depth understanding of the relationship between the Instructor Factor and academic outcomes. While there is a suggestion of a potential influence of the Instructor Factor on student performance, the evidence is not robust enough to draw definitive conclusions. These findings underscore the complexity of factors contributing to student outcomes, and further investigation, incorporating additional variables, may provide a more comprehensive understanding of the relationship between the Instructor Factor and academic achievement in communication skills courses.

Table 3: Summary of the regression analysis

	Model Summary			ANOVA			
	R	R^2	*B*	*F*	SE	t Stat	P-value
Instructor	.094	0.009	-0.429	3.175	.24	-1.782	.076

6. Discussion

The non-significant result in the t-test comparing the mean scores of students in the Google Classroom group and the No Google Classroom group suggests that using Google Classroom as a central instructional platform did not lead to a statistically significant difference in students' academic performance. One plausible explanation for this outcome could be the limited duration of the study. A longer-term investigation may offer a more comprehensive understanding of the sustained impact of technology integration on academic performance.

Additionally, the specific focus of the communication skills course on verbal and interpersonal communication might have minimized the advantages offered by the technology-driven approach of Google Classroom over traditional teaching methods. It is essential to consider the course's content and learning objectives when evaluating the impact of technology.

Turning to the regression analysis examining the Instructor Factor, the non-significant result at the conventional 0.05 significance level indicates that, on average, there is no statistically significant association between the instructor assigned to the course and students' academic performance—however, the marginal association suggested by the negative coefficient of -0.429 warrants careful interpretation. Possible explanations for this marginal association include variations in teaching styles, grading practices, or other instructor-related factors that, while present, do not reach statistical significance in the observed sample. The small effect size further underscores the need for caution in generalizing these findings.

Future research could delve deeper into instructor-specific variables, such as teaching methods, feedback approaches, and classroom management, to unravel the nuanced dynamics influencing student outcomes.

Engineering students are often driven by clear academic and career goals, prioritizing acquiring technical skills and knowledge relevant to their chosen field. This goal-oriented approach may lead them to view courses like communication skills as necessary to obtain their degree and meet their career objectives. Consequently, the motivation to pass the course might overshadow a critical assessment of instructional methods or variations among instructors. However, focusing on passing courses increases the potential importance of effective instructional strategies and teaching styles, even for students primarily driven by goal-oriented motives. Optimizing the learning experience can benefit their overall development and future professional success. Therefore, while the current findings offer insights into the characteristics of engineering students, they also underscore the significance of tailoring instructional strategies to meet the unique needs and motivations of students in different academic disciplines.

Implications for future research involve a more in-depth exploration of the role of technology in different course types and disciplines. Understanding the specific contexts in which technology proves beneficial or falls short can guide educators in making informed decisions about instructional tools. Exploring student perceptions, preferences, and engagement levels with technology could provide insights into the factors influencing its effectiveness in enhancing academic performance. Moreover, understanding the interactions between instructors, students, and technology is paramount. Future studies should investigate the dynamics of instructor-student relationships, communication patterns, and feedback mechanisms in the context of technology use. Such research can contribute to a comprehensive understanding of how these interactions mediate or amplify potential disparities in student outcomes.

In conclusion, these recommendations aim to extend and refine our understanding of the complex interplay between instructors, technology, and student learning outcomes. By addressing these research avenues, scholars can contribute to the ongoing discourse on effective educational practices in the ever-evolving landscape of technology integration.

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