

The Association Between Technology-Based Multitasking and Students' Academic Performance at Rangsit International College

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Abstract

Cognitive load, technology usage, and academic performance in higher education have been closely associated, and digital multitasking among students has become increasingly common. According to the Threaded Cognition Theory, multitasking can be symbolized by different task threads in the human brain, and when the same task threads require the same mental resource, conflict arises. However, the effects of multitasking and digital distractions among undergraduate students at Rangsit International College have not yet been fully explored, and the aim of this study was to explore the impact of multitasking with technology on RIC students' GPA. A quantitative research approach was used to collect data through an online survey using a structured Google Forms questionnaire among RIC students. The questions were constructed in a linear regression framework, and the results were analyzed using Python libraries and several statistical methods. The findings indicate that the overall regression model was statistically significant (p -value = 0.028) but explained a small proportion of the variance in GPA ($R^2=0.046$, adjusted $R^2=0.031$). Digital multitasking ($\beta=0.004$, p -value = 0.946) and cognitive load ($\beta=-0.022$, p -value = 0.588) were not statistically significant predictors of GPA. In contrast, technology use demonstrated a significant positive association with GPA ($\beta=0.137$, p -value = 0.004). These results suggest that commonly held assumptions about the detrimental effects of digital multitasking may be overstated in this context. This research provides empirical, evidence-based insights for educators and administrators at RIC, supporting more balanced and data-informed approaches to technology use in academic settings rather than restrictive or punitive policies.

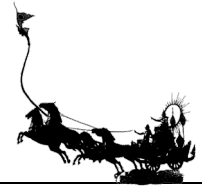
Keywords: digital multitasking, cognitive load, technology use, GPA, linear regression, cross-sectional study

1. Introduction

As humans opt to lead more fast-paced lives, the act of executing two or more actions simultaneously, more commonly referred to as multitasking, has become a mundane albeit pivotal part of society. Today, technology's accelerated emergence into the 21st century has resulted in humans coexisting with multiple digital devices, such as smartphones, laptops, and more, which raises concerns about the potential merits and demerits of multitasking with technology. The cognitive ability to manage deadlines and surges of information has been effortless for some but rigorous for others, especially for students and their academia, and the Threaded Cognition Theory conceptualizes multitasking as the operation of multiple task threads in the human brain, where each thread utilizes different mental resources (Salvucci & Taatgen, 2008). Parallel processing is feasible when task threads rely on distinct resources; however, conflicts arise when multiple threads vie for the same resource, causing delays and hindering effective multitasking. Utilizing the basis of this theory, this research aims to examine how digital multitasking behaviors, cognitive load, and the effect of technology interact to influence academic performance among Rangsit International College (RIC) students.

In higher education, grade point average (GPA) is a widely accepted measure of academic success, strongly correlating with cognitive abilities, motivational strategies, and traits related to achievement (Richardson et al., 2012). While existing literature has examined the relationship between technology and academic

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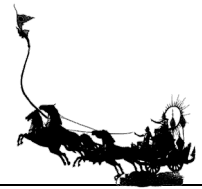


performance, little is known about the simultaneous effects of digital multitasking, cognitive load, and technology use on students' GPA, particularly in multicultural settings like RIC. This study addresses this research gap by investigating how these independent variables interact and are associated with academic performance.

Nowadays, human beings have extensive experience with multitasking, which has always been an innate human ability dating back to when early bipedal ancestors carried out toolmaking, childcare, and survival activities (Smith, 2010). It can be asserted that in accordance with the growth of complex civilizations and technologies, the methods of multitasking have also evolved and adapted in conformity with technological and digital tools. Initially, the term multitasking originated from the parallel processing ability of computers, and now it has been adopted to describe the human ability to simultaneously carry out as many things as possible, preferably maneuvering the use of many technologies at once (Rosen, 2008). Intricate methods such as explicit evolutionary multitasking (EEMT) have also been introduced into the computational intelligence and algorithm optimization field, where algorithms are programmed to solve multiple problems simultaneously by intentionally learning from and transferring knowledge between problems (Huang et al., 2024). As the world and humans advanced into the digital era, cross-national research reveals that college students in Kuwait, Russia, and the USA frequently perform media-nonmedia multitasking, where they pair electronic media, such as television, music, and phones, with everyday nonmedia activities like eating, socializing, and completing homework. This type of digital multitasking resulted in a positive correlation with perceived attention (Kononova et al., 2014).

Providing a valuable framework for understanding how multitasking impacts academic performance, the Cognitive Load Theory elaborates on cognitive load as the mental capacity inside the human brain to process information in working memory (Sweller, 1988). There are three main types of cognitive load, namely intrinsic load, extraneous load, and germane load (Sweller, 2011). Referred to as intrinsic cognitive load, the first necessitates higher cognitive load due to the difficult intrinsic nature of a particular piece of information. This type of load can only be reduced by changing the topic learned or changing the learner's intelligence. Other information that imposes higher cognitive load not because of its intrinsic nature but because of deficient instructions and guidance creates extraneous cognitive load, which generally increases during multitasking. It has been stated that the split-attention and redundancy effects during multitasking result in extraneous load and brain fatigue (Sweller, 2011). When this type of poorly presented information is processed, the human brain executes understanding, organizing, summarizing, and more using germane cognitive load, which is typically encouraged to cope with high extraneous load caused from multitasking (Sweller, 2011). According to a study on 265 undergraduate students, where they had to simultaneously watch a video and take a survey (multitasking) or watch a video and then take a survey (single-tasking), it was calculated that multitaskers performed with a 45% deficit compared to single-taskers (Doolittle et al., 2024). Correspondingly, an fNIRS experiment on 31 undergraduate students at the University of Victoria, Victoria, Canada, confirmed evidence of higher subjective and extraneous load, inaccuracies, and prefrontal detachment during multitasking conditions (Boere et al., 2024). In contrast to extraneous cognitive load, the factor representing germane cognitive load during class lectures was positively correlated with better exam performance (Leppink et al., 2014). Hence, RIC students and educators should develop strategies that minimize extraneous cognitive load to optimize germane cognitive load and academic outcomes (Liu et al., 2024).

Within the premise of student multitasking, technology can be both a detriment and a potential benefit to students' academic performance. The advancement of technology has shifted classroom culture into a digital zone where it is a convention for students to bring their digital devices and collaborate with technology for their education. On account of the recent COVID-19 pandemic, this use of technology and digital learning tools has subsequently become more influential than before; however, the effectiveness of technology on student education is rather dubious on its own but dependent on the pedagogical approach, moderated by educators, that aligns with clearly defined educational goals (Timotheou et al., 2023). As opposed to unrestricted technological usage, which is associated with lower academic results, guided and purposeful technological use has been proven to have better



educational outcomes, according to a descriptive statistical analysis conducted across three university centers in China, Poland, and Romania (Kot et al., 2017). Media multitasking, which is a type of unrestricted technological usage that revolves around the concurrent and overlapping use of several forms of media, is deemed alarming since it has been confirmed that more interactive media (computers) are more likely to dominate users' attention and prompt frequent shifts than less interactive media (Brasel & Gips, 2011). In regard to the Threaded Cognition Theory, this form of unrestricted use of technology (media multitasking) uses merely a single cognitive thread for several tasks and may potentially disrupt students' focus during learning (Salvucci & Taatgen, 2008). Additionally, students who are not equipped with a cell phone during lectures have significantly higher levels of course comprehension and lower levels of anxiety (Huey & Giguere, 2023).

Few studies have investigated the combined impact of the three independent variables: digital multitasking, cognitive load, and technology use within university contexts, particularly in multicultural and tech-rich environments like Rangsit International College (RIC). Hence, this study aims to investigate how digital multitasking, cognitive load, and technology use are associated with the GPA of students at Rangsit International College. It focuses solely on the relationship between the three independent variables digital multitasking, cognitive load, and technology usage and the dependent variable, academic performance (GPA), while excluding other influencing factors. The target population comprises international students majoring in 'International Business' and 'Information and Communication Technology' at RIC during the first semester (August to December) of the 2025 academic year. This research contributes to a deeper understanding of the relationship between technology, multitasking, and higher education, enriching discussions on academic efficiency and student success at RIC.

2. Objectives

- 1) To investigate how digital multitasking behaviors are associated with students' focus and academic performance in higher education institutions like Rangsit International College.
- 2) To examine the role of cognitive load in explaining the relationship between technology-based multitasking and academic performance.
- 3) To assess the overall impact of technology use on academic performance when considered alongside digital multitasking and cognitive load.

3. Materials and Methods

3.1 Conceptual Framework

Impact of Multitasking with Technology on RIC Students' Academic Performance

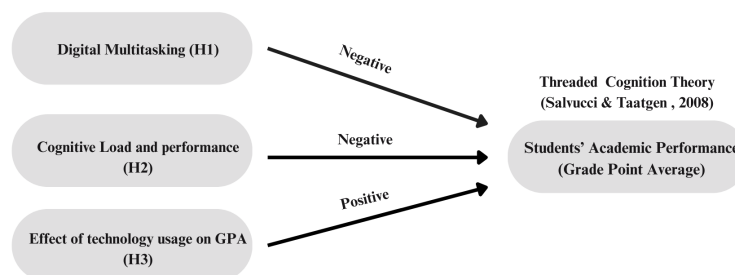
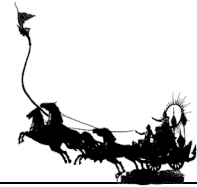


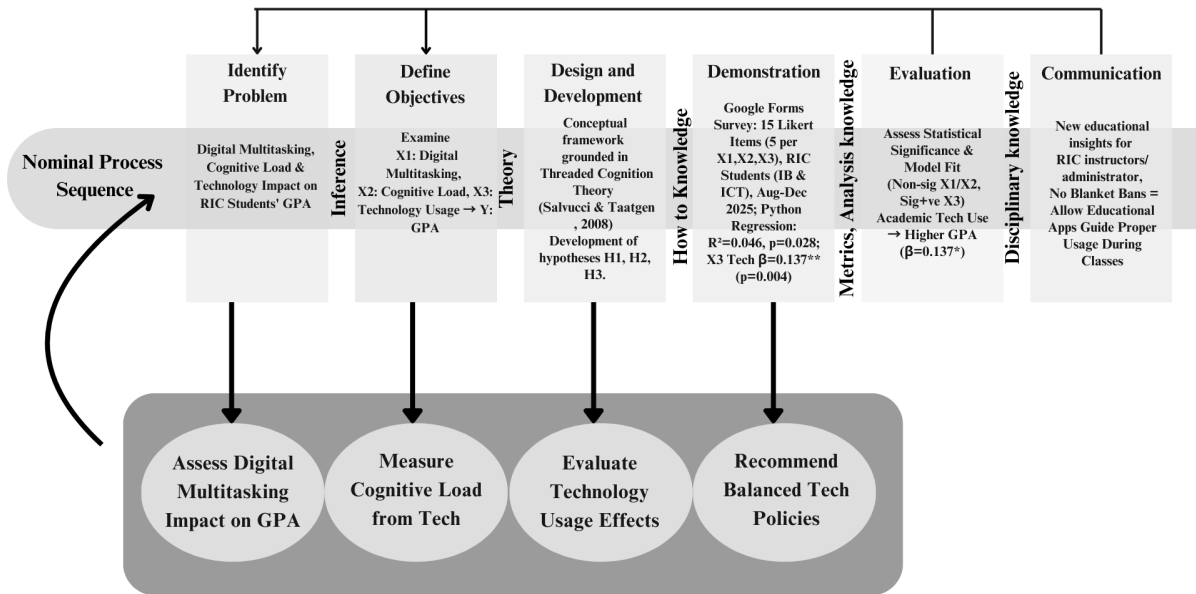
Figure 1 Conceptual framework



The conceptual framework for this study in Figure 1 was grounded in the Threaded Cognition Theory by Salvucci and Taatgen (2008). As stated previously, this theory explained how humans attempted to perform multiple tasks by simultaneously utilizing several cognitive “threads” that share limited mental resources. Within this framework, digital multitasking, cognitive load, and the effect of technology use were treated as independent variables that influenced the dependent variable, students’ grade point average, and the hypotheses were based on the relationships between the Threaded Cognition Theory and the independent variables.

Three hypotheses were developed, each corresponding to one of the independent variables. Hypothesis 1, which was associated with the first independent variable, digital multitasking, proposed that digital multitasking had a negative effect on students’ academic performance, as engaging in multiple digital activities simultaneously required frequent task switching, leading to reduced depth of information processing. Similarly, Hypothesis 2, regarding the independent variable, cognitive load, posited that cognitive load also negatively impacted students’ academic performance because excessive mental demands overwhelmed working memory capacity and increased the likelihood of errors during learning tasks. In contrast, Hypothesis 3 suggested that the third independent variable, the effect of technology use, had a positive impact on academic performance, as most students were required to use technology in classrooms and for academic tasks such as accessing course materials, completing assignments, and managing learning platforms.

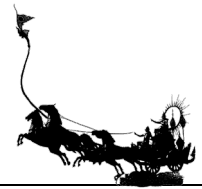
3.2 Research Design



Research Design

Figure 2 Research design

To identify the problem of this research, which is whether multitasking with technology has a positive or negative effect on students’ academic performance, this study employed a quantitative research methodology, allowing the assessment of correlations between digital multitasking (X1), cognitive load and performance (X2), the technology use (X3), and academic performance (Y).



The study targeted undergraduate students enrolled at Rangsit International College, primarily from the Information and Communication Technology (ICT) and International Business (IB) programs, excluding staff and lecturers. However, first-semester students were not included in the sample because they do not yet possess an official cumulative GPA, or their academic records are insufficiently stable to represent sustained academic performance. Excluding these students ensured the validity and comparability of academic performance measurements across participants.

Data were collected over one month in December 2025. Although the study is limited to a single institution, this context allows for a focused examination of technology-related learning behaviors within a comparable academic environment. The sample size was considered adequate to detect small effect sizes commonly reported in educational research, thereby supporting the statistical power of the analyses, while acknowledging that generalizability beyond similar higher education contexts may be limited.

3.3 Question Design

To collect data for this study, a structured questionnaire was developed and distributed via Google Forms. The survey was designed to assess the relationship between multitasking with technology and grade point average, as guided by the Threaded Cognition Theory. The form consisted of seven sections: an introductory statement with informed consent; demographic information; digital multitasking; cognitive load; technology use; grade point average; and an optional suggestions or feedback section. A total of 15 statements were used for the 3 sections representing the independent variables, with five items per section, all rated on a 5-point Likert scale ranging from 1 (Strongly Disagree/Worst Experience) to 5 (Strongly Agree/Best Experience).

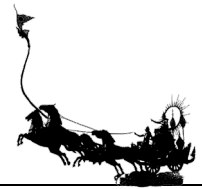
The questionnaire employed a variety of positively and negatively phrased statements to reduce response bias and ensure participant engagement. Some items used direct or linear phrasing, while others introduced reflective or contrastive elements. To enhance clarity and reduce confusion, bold font and clear instructional language was used throughout the form to guide participants in selecting the appropriate response options.

The reliability of internal consistency was assessed using Cronbach's alpha. The Cognitive Load scale demonstrated acceptable reliability ($\alpha = 0.759$), while Digital Multitasking ($\alpha = 0.529$) and Technology Usage ($\alpha = 0.584$) showed moderate internal consistency. As the instrument was self-developed for exploratory purposes, these reliability values are considered adequate for preliminary investigation. Future research should further refine and validate the measurement scales to enhance psychometric robustness.

3.4 Data Collection

Data for this survey were collected using an online survey administered through Google Forms over a period of one month. Participants were invited to take part in the survey through direct interaction on campus, where the research team approached students and personally displayed the QR code of the survey form, allowing students to scan and access the form instantly on their smartphones. This face-to-face approach helped ensure higher response rates and allowed for brief clarification if needed. In addition to on-campus engagement, the survey link was also shared via social media platforms, including LINE, Instagram, and Messenger, to reach a wider group of participants.

The first page of the form included a clear informed consent statement where disclaimers asking students for their GPA were presented. Participants who selected 'Yes' were allowed to proceed with the questionnaire, while those who selected 'No' were automatically excluded from the form. No personal information, such as name or age, was collected to ensure participant anonymity. To further certify consent and anonymity, the section that asks for GPA again states the assurance of no identification by informing participants that the research team will access and review the survey results only after the survey period has ended. All responses were automatically recorded and securely stored in Google Sheets, enabling efficient, organized, and confidential data handling for later analysis.



3.5 Data Analysis

Data analysis for this study used linear regression to evaluate how significant the impact of digital multitasking (X1), cognitive load and performance (X2), and the technology use (X3) is on academic performance (Y; GPA) among RIC students. Linear regression was selected because the dependent variable (GPA) and the composite independent variables are continuous, and the study aims to estimate the magnitude and direction of their relationships. Likert-scale responses (1= Strongly disagree/Worst to 5=Strongly agree/Best) will be numerically coded and rescaled from 0.1 to 0.9. This rescaling was applied to standardize measurement ranges across variables and to minimize boundary effects in regression estimation. Composite scores for each independent variable will be calculated by averaging the five items within each scale. This aggregation approach improves measurement stability and reduces item-level variability. GPA, originally measured on a 4.0 scale, will be standardized to a 0–1 scale by dividing by 4.0 to facilitate interpretability and comparability with the independent variables.

Prior to regression, data distributions and model assumptions are examined through both graphical and statistical methods. This step verifies the suitability of linear regression and the validity of inferential results. Histograms with kernel estimates are used to assess the distributions of the three independent variables. Residual normality is evaluated using Q-Q plots for each independent variable, and the Shapiro-Wilk test applied to the regression residuals, with a p-value greater than 0.05 indicating that the normality assumption is reasonably satisfied.

Model evaluation is performed using the coefficient of determination (R^2) to assess overall model fit and the proportion of variance in GPA explained by the independent variables. A detailed regression summary is generated using the Ordinary Least Squares (OLS) method in the statsmodels library, providing regression coefficients, standard errors, t-statistics, and p-values for hypothesis testing. All statistical analyses and visualizations are carried out using Python libraries, including scikit-learn, statsmodels, seaborn, and matplotlib, supporting analytical transparency and reproducibility.

4. Results and Discussion

This study examined the relationship between digital multitasking, cognitive load, and technology use and students' academic performance (GPA) among Rangsit International College students ($N = 196$) using multiple linear regression. Prior to hypothesis testing, descriptive statistics and model assumptions were examined.

4.1 Distribution of Independent Variables

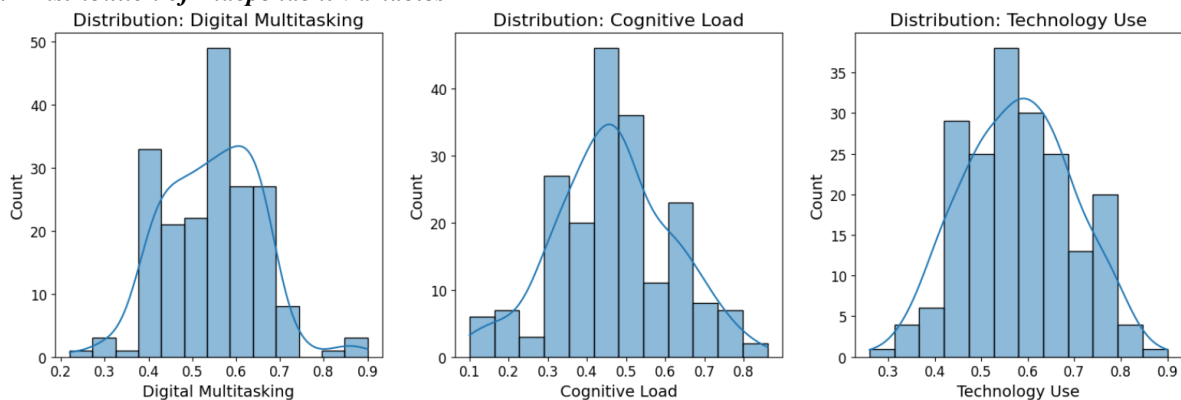


Figure 3 Histograms showing the distribution of digital multitasking, cognitive load, and technology use scores



Histograms with kernel density estimates (Figure 3) indicated that all three variables showed approximately normal distributions with minor skewness at the tails. Digital multitasking showed slight skewness, cognitive load displayed mild left skew, and technology use was approximately normal with moderate-to-high reported levels.

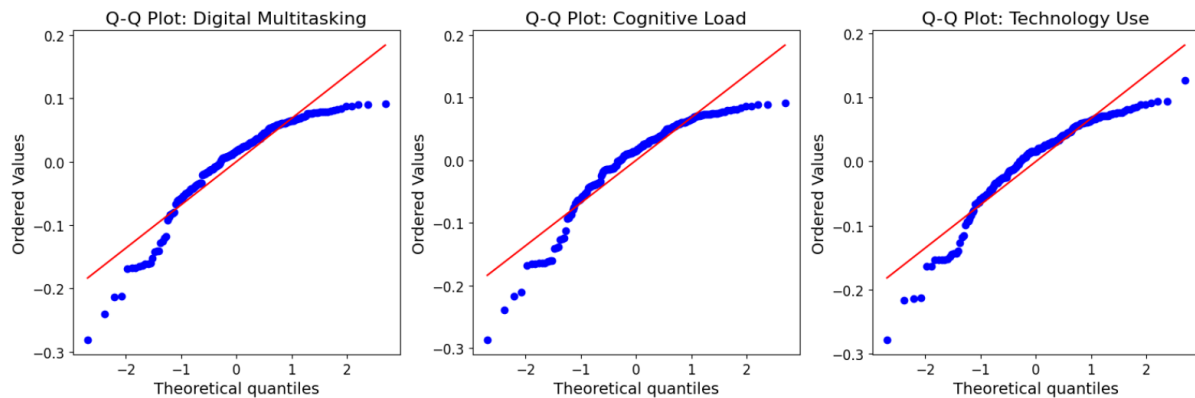


Figure 4 Normal Q-Q plots for digital multitasking, cognitive load, and technology use

Normality was further assessed using Q–Q plots for each independent variable (Figure 4). The plots showed mild deviations from the theoretical normal line at the tails, particularly for digital multitasking and cognitive load, indicating slight non-normality in the data distributions.

4.2 Regression Model Results

Table 1 Results of linear regression analysis on academic performance

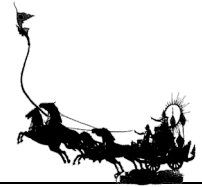
Predictor	β (Coeff)	Std. Error	t-value	p-value	95%CI (Lower)	95%CI(Upper)
Constant	0.843	0.031	27.523	<0.001	0.782	0.903
Digital Multitasking	0.004	0.056	0.067	0.946	-0.106	0.113
Cognitive Load	-0.022	0.040	-0.543	0.588	-0.100	0.057
Technology Use	0.137	0.047	2.878	0.004	0.043	0.230

A multiple linear regression model was estimated to evaluate the joint effects of digital multitasking, cognitive load, and technology use on GPA. The overall model was statistically significant ($F = 3.091, p = 0.028$). The explained variance was small ($R^2 = 0.046$; adjusted $R^2 = 0.031$), indicating that the predictors accounted for approximately 4.6% of the variability in GPA.

Among the predictors, technology use was positively and significantly associated with GPA ($\beta = 0.137, p = 0.004$), whereas digital multitasking ($\beta = 0.004, p = 0.946$) and cognitive load ($\beta = -0.022, p = 0.588$) were not significant predictors.

4.3 Model Diagnostics

Residual diagnostics indicated departures from normality. The Shapiro-Wilk test was significant ($W = 0.904, p < 0.001$), and skewness (-1.230) and kurtosis (4.477) suggested heavier tails. However, the Durbin–Watson statistic (2.088) indicated no serious autocorrelation. Overall, assumption checks suggested minor violations that do not invalidate interpretation but warrant cautious inference.



4.4 Discussion

This study investigated whether digital multitasking, cognitive load, and technology use predicted academic performance among Rangsit International College students. The overall regression model was statistically significant; however, the proportion of explained variance in GPA was small ($R^2 = 0.046$). This finding suggests that although technology-related behaviors were statistically associated with GPA, they accounted for only a small portion of the variability in academic performance. Therefore, GPA is likely influenced more strongly by other factors such as motivation, prior academic ability, learning strategies, socioeconomic conditions, or instructional quality, which were not included in the model. The results should therefore be interpreted with caution when considering their practical significance.

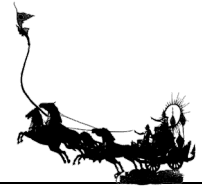
Contrary to the commonly held assumption that digital multitasking necessarily harms students' academic performance, Hypothesis 1 was not supported, and digital multitasking did not significantly predict GPA. This finding indicates that the present study did not detect a measurable association between multitasking behaviors and academic performance within this sample. While Threaded Cognition Theory proposes that simultaneous tasks compete for shared cognitive resources and may impair performance, the current results do not provide empirical support for such an effect in relation to overall GPA. One possible explanation is that GPA, as a cumulative measure of performance across courses and time, may not capture short-term disruptions that occur during specific learning activities. Previous studies have also reported mixed evidence regarding the relationship between media multitasking and academic outcomes, suggesting that the impact of multitasking may vary depending on context and task demands.

Similarly, Hypothesis 2 was not supported, as cognitive load did not show a significant association with GPA. Although Cognitive Load Theory emphasizes that excessive extraneous load can impair learning processes, the present findings do not demonstrate a direct relationship between students' perceived cognitive load and cumulative academic performance. Another possible explanation is that GPA, as a cumulative measure, may not be sensitive to short-term cognitive overload experienced during specific learning activities. Additionally, students may have developed coping strategies, such as selective attention or task prioritization, which mitigate the negative effects of cognitive load in real academic settings.

In contrast, Hypothesis 3 was supported. Technology use showed a significant positive association with GPA, indicating that students who reported more effective or purposeful use of technology tended to report slightly higher academic performance. Although the effect was statistically significant, its practical magnitude should be interpreted cautiously given the overall low explanatory power of the model. Nonetheless, this finding is consistent with previous literature suggesting that guided and goal-oriented technology use, such as accessing learning platforms, digital resources, and collaborative tools, can enhance learning outcomes. Within the framework of Threaded Cognition Theory, technology that supports learning tasks may reduce unnecessary task switching and align cognitive resources with academic goals, thereby facilitating more efficient information processing.

Taken together, the findings suggest that technology itself is not inherently detrimental to academic performance. Rather, the way technology is used appeared to be more important than the mere presence of multitasking behaviors. The findings therefore highlight the importance of how technology is used rather than simply whether it is used. However, given the small effect sizes and the cross-sectional design, the results should not be interpreted as evidence for strong causal relationships or definitive policy recommendations. Instead, they suggest that structured and academically oriented uses of technology may have modest benefits that warrant further investigation.

This study also offers several contributions. First, it extends the application of Threaded Cognition Theory and Cognitive Load Theory to the context of contemporary digital learning environments among international college students. Second, by examining multiple technology-related variables simultaneously, the study provides a more integrated perspective on how multitasking behaviors, perceived cognitive load, and



technology use relate to academic outcomes in a real academic setting, offering practical insights that can inform RIC instructors and academic administrators in designing learning activities, managing technology use in the classroom, and supporting students' academic performance.

Several limitations should be acknowledged when interpreting these findings. First, the low R^2 value indicated that important predictors of GPA were not captured in the model, and therefore the explanatory power of the model is limited. Future studies should incorporate additional variables such as self-regulated learning, time management, academic motivation, prior academic achievement, and learning environment. Second, the violation of residual normality suggested that alternative modeling approaches, such as robust regression or bootstrapped confidence intervals, could be explored to improve statistical inference. Third, the reliance on self-reported measures introduced potential response bias, and future research could integrate objective behavioral measures of multitasking or digital usage logs.

Future research could also adopt longitudinal designs to examine how changes in multitasking behaviors and technology use influence academic performance over time. Experimental designs comparing structured versus unstructured technology use in classroom settings may further clarify causal mechanisms. These directions would help refine theoretical applications of Threaded Cognition Theory and Cognitive Load Theory within contemporary digital learning environments while providing more robust evidence for practical educational implications.

5. Conclusion

This study investigated the relationships between digital multitasking, cognitive load, technology use, and academic performance among students at Rangsit International College, in line with the three stated objectives of the research. The overall regression model was statistically significant; however, the explanatory power of the model was limited, indicating that GPA was influenced by multiple factors beyond the three variables examined in this study.

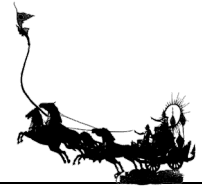
Regarding the three research objectives, the findings indicated that digital multitasking behaviors and cognitive load were not statistically significant predictors of students' GPA, suggesting that variations in students' multitasking habits and perceived cognitive demands did not have a measurable impact on cumulative academic performance among RIC students. In contrast, technology use demonstrated a statistically significant positive association with GPA, indicating that students who engage more effectively with technology for academic purposes tended to achieve higher academic performance.

Overall, the findings emphasized that technology-related behaviors do not exert uniform effects on academic performance. While multitasking and cognitive load did not show significant associations with GPA, purposeful technology use appeared to support academic achievement. These results provide evidence-based guidance for Rangsit International College to promote constructive and academically oriented uses of technology rather than generalized restrictions.

Future research could incorporate additional predictors of academic performance, such as learning strategies, motivation, time management, and prior academic achievement, to improve explanatory power. Longitudinal designs are also recommended to better capture causal relationships between multitasking behaviors, cognitive load, technology use, and academic performance.

6. Acknowledgements

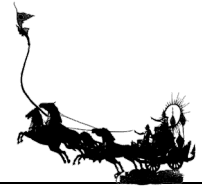
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