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Collaborative Learning as a Tool for Developing Critical Thinking Skills in Higher Education

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Abstract
This study examines collaborative learning as a tool for developing critical thinking-related academic engagement in higher education. Since the selected secondary dataset does not include a direct critical thinking scale, the study interprets critical thinking indirectly through learning behaviors associated with reflection, interaction, academic engagement, and student performance. The study adopted a secondary quantitative research design using the open-access Higher Education Students Performance Evaluation dataset. The dataset included 145 higher education student records. Collaborative and active learning indicators included peer preparation, classroom discussion, flipped classroom usefulness, attendance, note-taking, listening in class, study hours, reading frequency, cumulative GPA, expected GPA, and final grade. Data were analyzed using descriptive statistics, cross-tabulation, chi-square tests, Spearman correlation, and ordinal logistic regression. The results showed that students who perceived classroom discussion and flipped classroom practices positively had higher mean final grades. However, collaborative learning indicators such as peer preparation and classroom discussion were not statistically significant predictors in the regression model. Reading frequency and previous cumulative GPA emerged as the strongest significant predictors of final grade. The findings suggest that collaborative learning may support conditions for critical thinking development, but its effectiveness depends on structured interaction, instructional design, and active academic engagement. The study contributes by using secondary student-performance data to examine collaborative learning and critical thinking-related engagement in higher education.

Keywords: collaborative learning; critical thinking; higher education; student performance

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1. Introduction

Critical thinking has been one of the focal learning outcomes anticipated of higher education as university students are becoming more and more expected to interpret information, evaluate evidence, solve complex problems and make informed judgments in academic, professional and social contexts. Modern higher education can therefore not be confined to the delivery of content. It should establish learning conditions where students are eager to challenge assumptions, compare views, develop arguments, and use knowledge when in situations they had not encountered before. According to the recent literature, the development of critical thinking is tightly linked to the innovative pedagogy, inclusive classroom practice, active engagement, and learning outcomes within the higher education (Bhuttah et al., 2024; Wang and Abdullah, 2024). In these lines, the approach to teaching that includes the interaction, discussion, reflection, and collective problem-solving are especially pertinent.

One of these pedagogical strategies is collaborative learning. It is defined as a learner-centric process where learners collaborate to discuss concepts, solve problems, explain concepts, and construct knowledge in a peer-to-peer interaction. Instead of making the students passive receivers of information, collaborative learning promotes the students to be active participants in the learning process. The higher education evidence indicates that collaborative problem-solving may help to promote critical thinking because it needs students to consider alternative options, justify decisions, negotiate meaning, and respond to various viewpoints (Xu et al., 2023). Likewise, active collaborative learning as well as classroom interactivity have been associated with critical thinking due to their increased opportunity of reasoning, communicating, and engaging in reflection (González-Cacho and Abbas, 2022).

The increasing popularity of digital and blended learning settings has further increased the applicability of collaborative learning. Online and technology-supported spaces may offer the space of peer-to-peer discussions, shared inquiry and group-based learning but their success will depend on the quality of interaction between students. Bach and Thiel (2024) highlighted that the quality of digital interaction plays a crucial role in collaborative online learning because meaningful exchange, mutual responsiveness, and engagement at the group level are critical to productive collaboration. Ng et al. (2022) also demonstrated that the structure and effectiveness of the learning environment determines the performance of students in online collaborative learning. These studies imply that collaboration does not necessarily enhance learning; on the contrary, its effectiveness is determined by the manner in which interaction is structured, facilitated, and related to academic work.

Collaborative learning is also closely related to student engagement and academic performance. Miguel et al. (2023) revealed that group profile, engagement, and academic performance were linked to collaborative learning in management education, which meant that peer interaction could impact both the ways and the results of learning. This is significant to the current study since critical thinking is usually exhibited, not only in direct reasoning tests but also in academic behaviors like preparation, discussion, reading, participation and performance. Similar results are demonstrated by active learning research that indicates that higher education students are benefiting when they are engaged in learning activities that require interaction, application, and reflection as opposed to passive listening (Ribeiro-Silva et al., 2022). Collaborative learning can therefore be perceived as a subset of an overall active-learning framework which facilitates higher-order learning.

Along with collaborative learning, similar pedagogical models like problem-based learning, blended learning, and flipped classroom teaching have been discovered to contribute to the development of critical thinking. Problem-based learning prompts students to examine real or simulated problems, find evidence that is relevant, and develop reasoned solutions. Yu and Zin (2023) have observed that problem-based learning models can be modified in particular to enhance critical thinking. Blended learning may facilitate critical thinking, as well, by balancing independent preparation with interactive classroom learning (Lu, 2021). Likewise, the flipped classroom strategies enable the students to review the material before the lesson, and use the lesson time to discuss, apply, and solve problems. As Baig and Yadegaridehkordi (2023) emphasize, the role of the flipped classroom in higher education is increasing, whereas Prabowo et al. (2022) demonstrated that the student engagement and learning conditions influence the performance of online learning.

Even though the literature is increasing, there is still a significant gap in research. Numerous studies in the area of collaborative learning and critical thinking are based on the use of primary surveys, experimental

interventions, or perception-based instruments. A smaller number of studies make use of secondary data on student-performance to examine the relationship between indicators of collaborative and active learning and academic outcomes. This applies since data on student performance usually encompasses behavioral predictors like classroom attendance, study behavior, frequency of reading, peer preparation, and GPA. Even though such variables are not related to direct measurement of critical thinking, they may provide indirect evidence of learning behavior related to the analysis and reflection. Campo et al. (2023) stressed that the views of students towards methodologies used to develop critical thinking are crucial, whereas Rivas et al. (2022) argued that metacognitive strategies play an important role in the development of critical thinking. Such observations justify the adoption of engagement-related variables as significant, albeit indirect, predictors of learning that is oriented towards critical thinking.

Thus, the current paper discusses collaborative learning as a means of developing academic engagement of critical thinking in higher education using secondary data on student-performance. Some of the variables that the study is interested in include peer preparation, classroom discussion, usefulness of flipped classroom, attendance, frequency of reading, cumulative GPA, and final grade. This is not aimed at making a claim as to whether or not collaborative and active learning indicators are related to academic performance patterns that might be indicative of higher-order learning. In this way, the research will contribute to the existing debates on how collaborative learning, active engagement, and data on the student performance can be utilized to understand the development of critical thinking in higher education.

2. Methodology

2.1 Research Design

The current research design is a secondary quantitative research design to investigate patterns of assessment on academic performance of students. The article is concerned with examination-oriented learning, therefore, the research employs an existing educational dataset to test the relationship between final academic performance and the previous grades, study habits, attendance, previous failures, and the chosen school and family-related factors. A secondary data design is suitable since it enables the researcher to review prior gathered student-level data, without necessarily going to the field. This design also enables objective statistical investigation of the variables that have a direct or indirect relationship with the examination performance and learning outcomes. The research is quantitative since it involves measurements of the variables and statistical methods to determine the relationship and predictive patterns of the data.

2.2 Data Source

The research is based on the open-access dataset of Higher Education Students Performance Evaluation downloaded on Kaggle (Safrit, n.d). The dataset is related to the research by Yilmaz and Sekeroglu (2019), who investigated the student performance classification based on the artificial intelligence methods. The dataset is student-level data gathered among the higher education students and includes variables on the demographic background of the students, characteristics of the family in which the students are brought up, the educational habits of the students, how the students participate in the classroom, the behavior of the study students in studying, and academic performance of the study students. To conduct the current article, the data is utilized not to primarily perform an artificial intelligence classification of the data, but to analyze how collaboration- and active learning-related variables relate to academic outcomes. This dataset is appropriate to be used because it contains the following variables: preparation with friends: exams, grades, test grades; perceived usefulness: classroom discussion, attendance, listening in classroom, note taking, reading habits, and GPA related outcomes.

2.3 Population and Sample

The sample that is represented in the dataset is made up of students in higher education. The initial data set contains the answers of students at university level and documents their academic and other related learning attributes. As the research employs the use of secondary data, the sample size, the demographic distribution as well as the institutional context are assumed as reported in the dataset. The unit of analysis is the individual student. The dataset was screened to determine the completeness and usability of the data and all valid student records in the dataset were considered to be analyzed. The researcher did no further sampling since the data was already collected and publicly released to be used in research.

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2.4 Variables of the Study

The indicators of collaborative learning and active learning are considered independent variables in the study. These are preparation of midterm exams, whether it was done individually or with friends, perceptions on whether classroom discussion enhances interest and success, perceived usefulness of flipped classroom practices, attendance, in-class listening, note-taking, weekly hours of study, and weekly frequency of reading. These variables are learning behaviors which can facilitate interaction, reflection, explanation, questioning, and building knowledge.

The dependent variables are the measures of academic performance that can be found in the dataset. These include final output grade, previous semester cumulative grade point average, and expected cumulative grade point average at graduation. Examples of control variables are age, gender, department or course identification, scholarship type, parental education, parental occupation and any other background characteristics. These variables have been added in order to minimize the chances that we are finding relationships that can be explained only by demographic or socioeconomic factors.

2.5 Operationalization of Critical Thinking

This study operationalizes critical thinking in an indirect manner. The dataset lacks a direct psychometric test of critical thinking, i.e. a validated critical thinking test or rubric. Thus, critical thinking is considered a higher-order learning outcome that manifests itself in behaviors that are theoretically correlated with analytical and reflective learning. These behaviors involve involvement in classroom discussion, preparation that is supported by peers, active listening, taking notes, regular reading, and participation in flipped classroom activities. In this regard, collaborative learning is discussed as a pedagogical state which can facilitate the academic behaviors related to critical thinking. The findings interpretation is thus tentative and does not purport to directly measure critical thinking.

2.6 Data Preparation and Analysis

The data set was screened to familiarize with its variables names, coding scheme and category of response. It had 145 valid records of students and 33 variables. Interesting variables were grouped into three categories: collaborative learning indicators, active engagement indicators, and academic performance indicators. Preparation to take midterm examinations and the perception of students whether the classroom discussion increased interest and success were indicators of collaborative learning. Indicators of active engagement included attendance, the practice of taking notes, classroom listening, hours of study per week, the frequency of reading, reading scientifically, and perceived usefulness of the flipped classroom. The indicators of academic performance were final grade, past cumulative GPA, and anticipated graduation GPA.

Data screening was done to verify the absence of missing values, inconsistent coding and the appropriateness of categorical and ordinal variables in the analysis. The selected variables did not have any missing values. The initial final grade variable was kept as a correlation and ordinal regression variable. To perform cross-tabulation and chi-square tests, the final grades were recoded into three performance bands, low performance, moderate performance, and high performance.

Descriptive statistics, cross-tabulation, chi-square tests, Spearman correlation, and ordinal logistic regression were all part of the analysis. The distribution of the learning behaviors and academic outcomes were summarized by descriptive statistics. Evidence of the relationship between collaborative or engagement-related variables and performance bands was determined by cross-tabulation and chi-square tests. The mode of correlation was Spearman correlation since the majority of the variables were ordinal. Lastly, the ordinal logistic regression was used to determine whether the indicators of collaborative learning and active engagement predicted the final grade of students.

3. Results

3.1 Profile of the Dataset

The analysis was performed based on the Higher Education Students Performance Evaluation dataset, which includes student-level information related to demographic characteristics, learning habits, classroom engagement, indicators of collaborative learning, GPA, and final academic performance (Yilmaz and

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Sekeroglu, 2019). Following data screening all 145 student records were retained to be analyzed since no missing values were determined in the selected variables.

As depicted in Table 1, the sample mainly comprised of students aged 22 to 25 years, and 48.3 percent of the dataset, with the other 44.8 percent of the dataset being represented by students aged 18 to 21 years. The sample was 60.0 percent male students and 40.0 percent female students. The final grades dispersion revealed that the greatest percentage of students were in the low performance levels which includes Fail, DD, and DC grades. In particular, 67 students, or 46.2 percent, belonged to the low-performance group, and 48 students or 33.1 percent belonged to the moderate-performance group. The high-performance group, which comprised of BA and AA grades, had 30 students or 20.7 percent of the sample.

Table 1: Demographic and Academic Performance Profile of Students

Variable	Category	Frequency	Percentage
Age	18–21 years	65	44.8
	22–25 years	70	48.3
	Above 26 years	10	6.9
Gender	Female	58	40.0
	Male	87	60.0
Grade band	Low: Fail, DD, DC	67	46.2
	Moderate: CC, CB, BB	48	33.1
	High: BA, AA	30	20.7

The final grade distribution in detail is shown in Figure 1. In the order of highest grades, DD, DC, and CC were given to the students. Comparatively smaller number of students were grouped within the highest performance brackets and yet the AA bracket had 17 students. Such distribution shows that the data has a large enough amount of variation in academic performance that it could be used to perform comparative and correlational analysis.

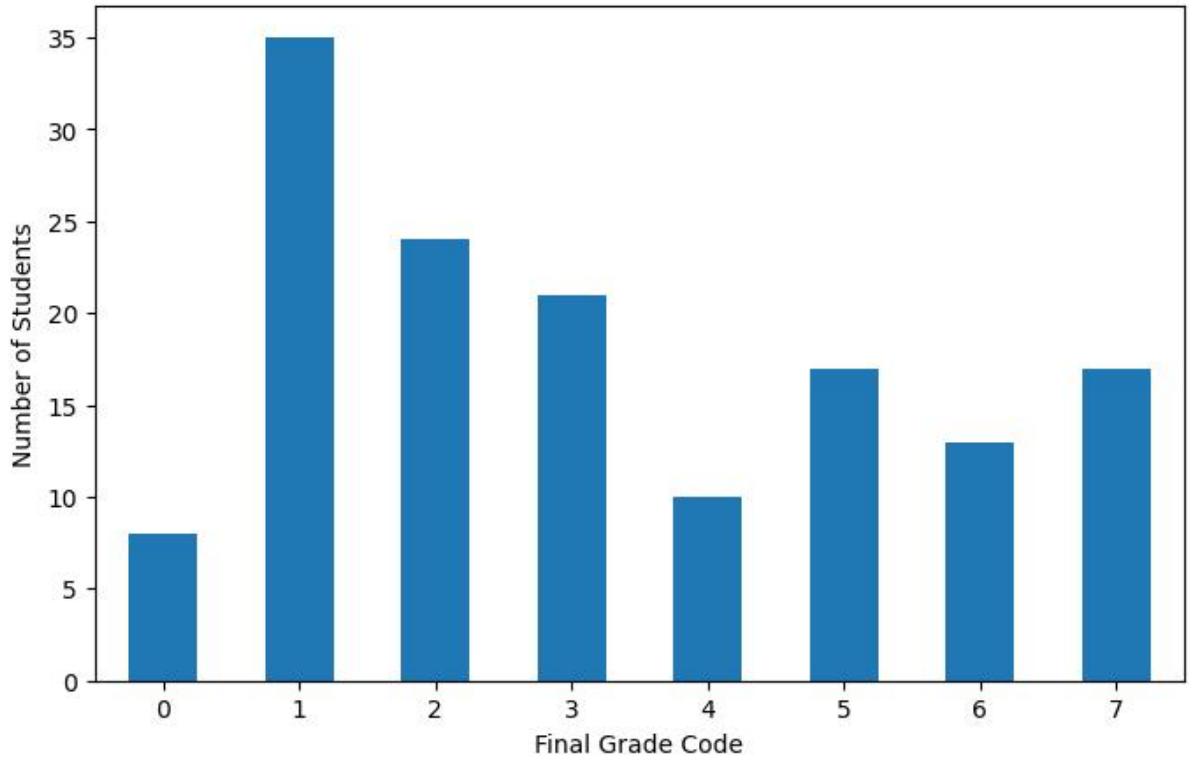

Figure 1: Distribution of Final Grades among Higher Education Students

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3.2 Distribution of Collaborative and Active Learning Indicators

Table 2 shows the descriptive analysis of indicators of collaborative and active learning. The majority of students said that they studied midterm examinations on their own. In particular, 107 students, or 73.8 percent, prepared alone, and 27 students or 18.6 percent prepared with friends. The final grade was a bit better among students who prepared alone compared to students who prepared with friends. Nevertheless, students who answered not applicable had the highest mean grade but this was a small category and should be used with caution.

The variable of classroom discussion indicated a more regular pattern. Students who reported that discussion always makes them more interested and successful had a higher mean final grade of 3.48, as opposed to 3.14 among those who selected the "sometimes" option and 2.00 among those who selected the "never" option (see Table 2). This pattern implies that the more positive attitudes to discussion-based learning are linked to more favorable academic performance. In the same way, the mean grade of students who perceived the practice of flipping the classroom to be useful was 3.56, as compared to 2.89 with the students who did not find the practice of flipping the classroom to be useful.

Table 2: Collaborative and Active Learning Indicators with Mean Final Grade

Variable	Category	Frequency	Percentage	Mean Grade
Preparation for exams	Alone	107	73.8	3.27
	With friends	27	18.6	2.78
	Not applicable	11	7.6	3.91
Discussion improves interest and success	Never	9	6.2	2.00
	Sometimes	70	48.3	3.14
	Always	66	45.5	3.48
Flipped classroom usefulness	Not useful	64	44.1	2.89
	Useful	45	31.0	3.56
	Not applicable	36	24.8	3.42
Attendance	Always	110	75.9	3.40
	Sometimes	35	24.1	2.69
Reading frequency	None	27	18.6	2.41
	Sometimes	99	68.3	3.32
	Often	19	13.1	3.89

The trend expressed in Figure 2 further supports the fact that, students who attached more importance to classroom discussion were likely to have higher mean grades. It is applicable to the current research since one of the most obvious signs of collaboration in learning that can be identified in the dataset is discussion-based interaction. Even though the data set does not directly measure critical thinking, classroom discussion can be understood as a learning condition that promotes explanation, comparison of ideas, questioning and reflective thinking.

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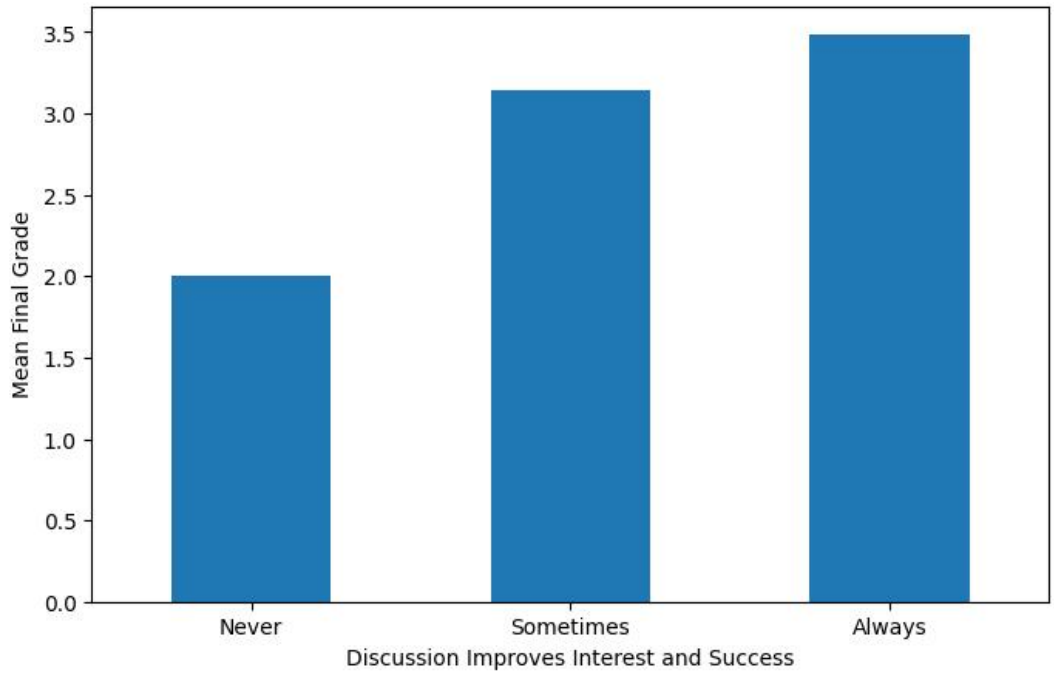

Figure 2: Mean Final Grade by Perceived Value of Classroom Discussion

The frequency of reading was also clearly displayed in descriptive pattern. Students who reported reading also had the highest mean final grade of 3.89 and those students who did not read had the lowest mean grade of 2.41 as presented in Figure 3. This implies that the independent academic activity especially reading might be a significant aspect that is related to the high achievement.

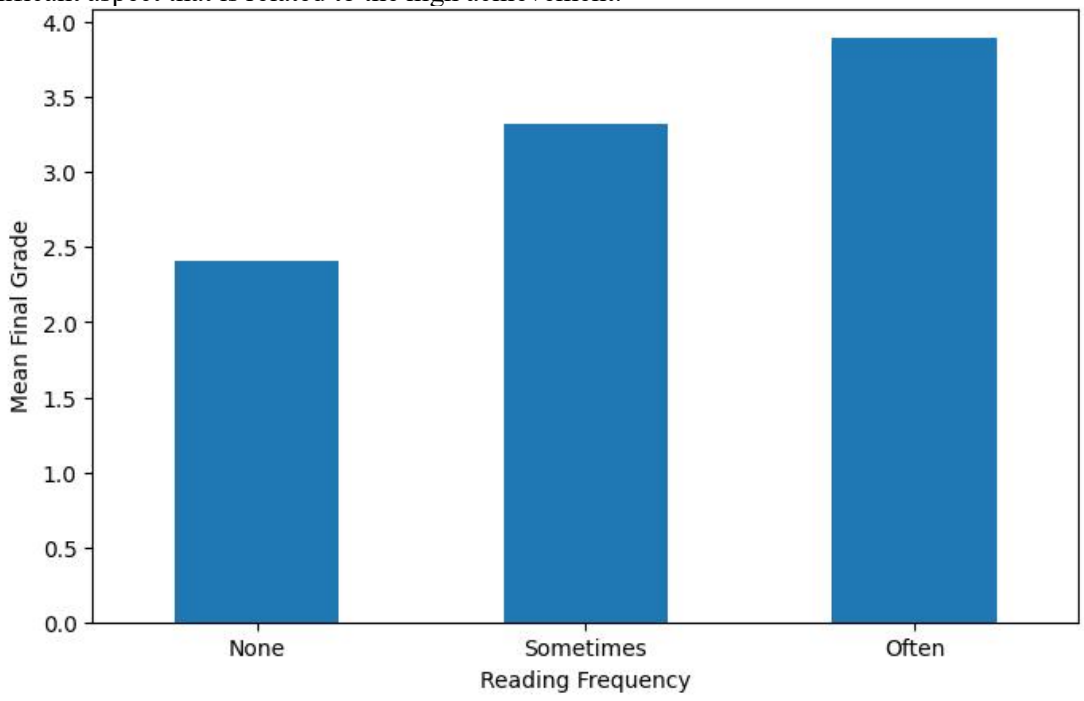

Figure 3: Mean Final Grade by Reading Frequency

3.3 Association between Collaborative Learning Indicators and Academic Performance

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Chi-square tests were conducted to examine whether selected collaborative and active learning indicators were associated with grade-band categories. The results showed that preparation style was not significantly associated with grade band, $\chi^2(4) = 2.301$, $p = .681$. Similarly, the association between classroom discussion and grade band was not statistically significant, $\chi^2(4) = 6.005$, $p = .199$. Flipped classroom usefulness was also not significantly associated with grade band, $\chi^2(4) = 4.832$, $p = .305$.
However, some engagement variables showed marginal associations. Attendance approached statistical significance, $\chi^2(2) = 5.442$, $p = .066$, suggesting that students who attended classes more regularly tended to have better academic outcomes. Weekly study hours also showed a marginal association with grade band, $\chi^2(8) = 14.813$, $p = .063$. Reading frequency showed a similar marginal pattern, $\chi^2(4) = 8.750$, $p = .068$. Although these results did not reach the conventional .05 significance level, they indicate that academic engagement variables may be more strongly related to performance than peer preparation alone.

3.4 Correlation between Learning Indicators and Final Grade

The analysis of the correlation between the variables was done using Spearman correlation analysis since most of them were ordinal. The results of the correlation are summarised in Table 3. Final grade was positively but statistically non-significantly related to classroom discussion, $\rho = .148$, $p = .075$. The usefulness of flipped classes also exhibited a positive, though not significant relationship, $\rho = .118$, $p = .156$. The attendance had a negative relationship with grade, $\rho = -.148$, $p = .076$, but this is because lower values corresponded to stronger attendance. Thus, the direction would indicate that the higher the attendance, the better the performance.
The frequency of reading had a significant and positive relationship with final grade, $\rho = .175$, $p = .035$. Cumulative GPA of the past had the highest correlation with final grade, $\rho = .351$, $p < .001$. Final grade was also significantly related to expected graduation GPA, $\rho = .272$, $p = .001$. These results suggest that previous academic achievement and frequent reading behavior were the most stable predictors of ultimate academic achievement.

Table 3: Correlation and Ordinal Logistic Regression Results for Final Grade

Predictor	Spearman ρ	Spearman p	Ordinal Coefficient	Odds Ratio	Regression p
Preparation for exams	−0.019	.821	0.019	1.020	.948
Classroom discussion	0.148	.075	0.214	1.239	.410
Flipped classroom usefulness	0.118	.156	0.027	1.028	.892
Attendance	−0.148	.076	−0.310	0.733	.399
Note-taking	0.019	.820	−0.101	0.904	.724
Listening in class	0.097	.245	0.243	1.275	.276
Weekly study hours	−0.006	.939	−0.188	0.829	.300
Reading frequency	0.175	.035	0.857	2.356	.006
Scientific reading frequency	0.004	.960	−0.159	0.853	.605
Previous cumulative GPA	0.351	<.001	0.483	1.621	.004
Expected graduation GPA	0.272	.001	0.040	1.041	.864

3.5 Predictors of Final Academic Performance

A model based on ordinal logistic regression was employed to determine whether the indicators of collaborative and active learning predicted final grade. Final grade was the dependent variable which was coded as Fail to AA. Table 3 shows that reading frequency was a statistically significant predictor of final grade, $\beta = 0.857$, odds ratio = 2.356, $p = .006$. This implies that the higher the reading frequency of the students, the better the chances of ending in a higher final-grade category. Previous cumulative GPA was also a significant predictor, $\beta = 0.483$, odds ratio = 1.621, $p = .004$, showing that students with stronger prior academic performance were more likely to obtain higher final grades.

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In contrast, the collaborative learning indicators did not significantly predict final grade in the regression model. Preparation style was not significant, $\beta = 0.019$, $p = .948$. Classroom discussion was positive but not statistically significant, $\beta = 0.214$, $p = .410$. Flipped classroom usefulness was also non-significant, $\beta = 0.027$, $p = .892$. These results indicate that though discussion-based and active classroom variables depicted positive descriptive tendencies, they had less independent predictive power when other learning and academic variables were taken into consideration.

3.6 Summary of Results

All in all, the findings partially support the argument that collaborative and active learning processes are related to academic engagement in higher education. Students who said that classroom discussion helps improve interest and success had better mean final grades, and those students who perceived that classroom discussion practices are useful had stronger patterns of descriptive performance. The indicators of collaborative learning were however, not statistically significant predictors in the ordinal logistic regression model.

The most significant empirical results were associated with the frequency of reading and the cumulative GPA in the past. The frequency of reading was greatly correlated with end grade and significant in the regression model. This indicates that individual academic interaction might be a more effective performance related criterion than cooperative preparation in the current data set. The lack of the actual measurement of critical thinking implies that the results are to be viewed with some caution. The results suggest that collaborative learning can establish supportive conditions to promote critical thinking-related engagement, specifically, classroom discussion, but secondary data available provide indirect evidence of developing critical thinking, rather than direct evidence.

4. Discussion

The current research included indicators relating to collaborative learning and their correlation with academic performance on the basis of secondary data of higher education students. The findings give a tentative yet significant ground on which to discuss collaborative learning as a potential support system to the development of critical thinking. Even though the data did not include a direct psychometric measure of critical thinking, several variables, such as classroom discussion, peer preparation, flipped classroom usefulness, reading frequency, and previous GPA, were utilized as the indirect measures of the higher-order academic engagement.

The descriptive results demonstrated that students who indicated that classroom discussion enhances their interest and success achieved higher mean final grades, as compared to students who did not embrace the importance of discussion. This tendency proves the assumption that discussion-based learning can provide students with a chance to clarify the points, compare perspectives, justify their arguments, and think in a reflective manner. These processes are the focus of collaborative learning, and are also directly related to the development of critical thinking. This meaning aligns with that of Eskiyurt and Ozkan (2024), who discovered that collaborative learning can be used to support critical thinking and decision-making abilities by promoting interaction and shared reasoning. On the same note, Ouyang et al. (2024) pointed out that collaborative knowledge building, especially with the aid of argument mapping, can enhance the capacity of students to organize, evaluate, and defend ideas.

But the statistical tests indicated that classroom discussion and peer-based preparation were not significant predictors of final grade in the ordinal regression model. This implies that informal collaboration in itself might not be adequate to enhance academic performance unless structured, assessed and pedagogically guided. Similarly, Dias-Oliveira et al. (2024) argued that project-based learning is able to cultivate critical thinking skills, teamwork, and communication skills in case collaborative tasks are carefully designed. Thus, the non-significant effect of peer preparation in the current study could be a reflection of the limited manner in which the concept of collaboration was captured in the dataset, as opposed to the ineffectiveness of collaborative learning per se.

The results also indicated that the usefulness of flipped classroom had a positive descriptive relationship with mean final grade, but was not statistically significant in the regression model. This finding indicates that the flipped classroom strategies might help to promote the engagement of students, yet their efficiency can be

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influenced by the design of instructions, the preparation of students, and classroom integration. According to Baig and Yadegaridehkordi (2023), in higher education, approaches based on flipped classroom can potentially enhance engagement and learning, although implementation challenges often have an impact. In the current research, the variable of the flipped classroom might have been too broad to include the quality of pre-class preparation, in-class collaboration, and post-class reflection.

Another more empirical result was that reading frequency had a significant role to play. Students with higher frequency of reading received high final grades, and frequency of reading was still a strong predictor in the ordinal logistic regression model. This result indicates that independent academic inquiry is closely linked to performance, and can lead to critical thinking by exposing students to ideas, arguments, evidence and alternative perspectives. Writing-intensive and transparent learning practices were shown to promote critical thinking, which supports the notion that academic literacy practices are significant to encourage deeper thinking (Cronmiller et al. 2022). On the same note, Susanti et al. (2023) have concluded that problem-based learning enhances problem-solving and critical thinking, in part due to the fact that problem-based learning forces students to engage actively with information, rather than passively receiving it.

Cumulative GPA of the past was also a major predictor of the final grade, implying that past academic performance continues to be an important predictor of the current achievement. This result is not surprising since GPA reflects the accumulated academic habits, the level of conceptual knowledge, and discipline in learning. Mahanal et al. (2022) argued that problem-solving skills would be enhanced when the students are exposed to structured learning strategies that promote engagement and reflection. Thus, students who demonstrated higher previous performance might already have superior study-regulation, reasoning, and academic persistence.

The non-significant contribution of peer preparation must be also understood in the terms of peer evaluation and shared responsibility. Fleckney et al. (2025) have also noted that peer assessment is best achieved when criteria, feedback, and responsibilities of learners are well structured. In the current dataset preparation with friends was considered a simple category, but it did not specify whether students were engaged in an explanation, questioning, feedback, or critical dialogue. Therefore, the variable might not entirely depict excellent collaborative learning. Tedla and Chen (2025) also demonstrated that computer-supported cooperative learning can have the impact on critical thinking, but the effect is dependent on the nature and quality of interaction.

The results are applicable to the pedagogy of higher education. Collaborative learning cannot be just a group work or peer preparation. It ought to be structured based on purposeful activities like argument mapping, project work, problem-based learning, peer review and guided discussion. This is particularly crucial in the interdisciplinary and technology-mediated learning situations when the students require the opportunity to bridge the gaps between concepts and use the knowledge critically. Lin et al. (2019) demonstrated that interdisciplinary STEM learning could facilitate applied learning, whereas Tseng et al. (2019) emphasized the significance of self-regulation, motivation, and social skills in the context of online higher education learning.

In general, the research argues that collaborative learning can help to create conditions that lead to critical thinking especially via discussion, engagement and shared reasoning. Nonetheless, the best statistical results in this dataset were obtained with respect to reading frequency and previous GPA. Thus, the results must be viewed with a grain of salt: collaborative learning seems to have pedagogical significance, but direct assertions about the development of critical thinking await future research using validated measures of critical thinking, structured collaborative interventions, and longitudinal or experimental designs.

5. Conclusion

This paper explored collaborative learning as a possible tool in developing academic engagement related to critical thinking, in higher education, using secondary data in Higher Education Students Performance Evaluation dataset. The analysis centered on the peer preparation, in-class discussion, usefulness of flipped classroom, attendance, frequency of reading, GPA, and final grade. As the dataset did not consist of a direct critical thinking scale, critical thinking was indirectly interpreted in the form of learning behaviors related to reflection, reasoning, active engagement, and academic performance. The results indicate that the students who rated classroom discussion as helpful and the students who rated the practices of flipped classroom as

positive had higher mean final grades. These findings indicate that interaction-oriented and active learning contexts can facilitate more academic engagement. Nevertheless, collaborative learning predictors, like peer preparation and classroom discussion, were not statistically significant predictors in the ordinal regression model. Thus, the research fails to present first-hand evidence that collaborative learning on its own enhances critical thinking or academic achievement. The best results were connected with the frequency of reading and the historical cumulative GPA. The frequency of reading was also found to be significantly associated with the final grade and was also found to significantly predict in the regression model. This shows that independent academic engagement can continue to be a key contributor to student success and may also lead to critical thinking by further exposing students to ideas, arguments, and evidence. All in all, the paper finds that collaborative learning has the potential to provide conducive conditions to develop critical thinking; however, its success relies on its structure, instructional design, and meaningful student interaction. The guided discussion, peer feedback, problem-based tasks, flipped learning, and reflective reading activities should be integrated by higher education teachers. The validated critical thinking tools, primary data, and experimental/longitudinal designs should be used in future research to test the relationship more directly.

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