

Academic Performance in Transition to Online Distance Learning: An Assessment from Prior Academic Performance Across Subjects

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Abstract. Online distance learning (ODL) has spread worldwide in all levels of education, and academic performance is a frequently mentioned topic in the research of ODL. This research focuses on the impact of students' prior academic performance in different subjects on their academic performance in the context of transition from a traditional class to online distance learning. The participants are students from a key public high school in China. They took a traditional in-person class in their twelfth grade first semester and took ODL in twelfth grade second semester. Positive and strong Spearman and Pearson Correlation (~ 0.8) is found between student's academic performance during traditional class and student's academic performance during ODL; positive and weak Spearman and Pearson Correlation (~ 0.4) is found between student's academic performance during traditional class and the change of student's academic performance through the transition from the traditional class to ODL, indicating a positive correlation between prior academic achievement and later performance. Linear regression fitting is applied to the student's academic performance during traditional class and the student's academic performance during ODL, the results have shown that the prior academic performance represents by cumulative exam have a good prediction of the later academic performance in both traditional class and ODL context.

Keywords: Online Distance Learning, Academic Performance, Prior Academic Performance, Correlation.

1. Introduction

Along with the rapid growth of information technology, online distance learning (ODL) has spread worldwide in all levels of education [1]. The sudden outbreak of the COVID-19 pandemic forced conversion from the traditional classroom to a distant one and exacerbated the development of ODL, data from UNESCO demonstrates that 290.5 million students are affected due to COVID-19, and thirteen countries have shut schools nationwide, transfer the education to online. Such transition opened up a juncture for numerous researchers, the ODL has been extensively analyzed with procrastination, motivation, anxiety, self-efficacy, academic Performance, etc. [2,5]. The academic performance in ODL is especially worth studying, as it could be the indicator of the effects of ODL and traditional learning. Plenty of researchers have demonstrated a negative impact of ODL on students' academic performance, cross-sectional research from Mohamed A. A. Mahdy shows that 92% of participants ($n=1392$) from 92 different countries announce a negative impact of ODL on their academic performance due to the COVID-19 lockdown [6]. Students' demography such as gender, education level, personality, and self-efficacy are analyzed to predict their effects on academic outcomes during the ODL [5], other factors including teacher readiness, and government policy has been studied as well [7]. Though numerous research is done to find the factors influencing academic outcomes during the ODL and pandemic, few of them focus on the change before and after the pandemic, in other words, the transition from the traditional class to ODL. One possible reason is the difficulty to acquire data, as it is not easy to find students who take both types of education and use a consistent standard to evaluate their academic performance. Alyahyan and Düşteğör published a literature review and concluded five most influential factors in the prediction of students' academic performance: prior academic performance, student demographics, environment, psychological

attributes, and student e-learning activities, among these factors, prior academic performance such as high school background, GPA, CGPA, course mark was the most influential one and took up 44% of the research papers [8]. Thus, this research focuses on the impact of students' prior academic performance in different subjects on their academic performance in the context of transition from a traditional class to online distance learning. The key point in this research is to focus on the transition from a traditional class to ODL instead of two independent learning types.

Based on the above literature, it is obvious that academic performance during ODL has received attention from researchers, but a comprehensive and effective recognition of the academic performance during the transition from a traditional class to ODL hasn't been formed. Therefore, to better illustrate the transition of learning types, this study chooses class of 2022 from a public high school in China, who took traditional in-person class in their twelfth grade first semester, and due to the pandemic, took ODL in their twelfth grade second semester, and monitor their performance during the transition period. The transition of learning types between two sequential semesters makes the class of 2022 perfect subjects for this research. Referring to the suggested predicting model by Huang and Fang, this research would use the final grade in the twelfth-grade first semester as a representation of a student's prior academic performance and the final grade in the second semester would be a representation of the student's academic performance under ODL, detailed explanation would be provided in the method part [9]. It is important to conduct such research as it may fill the gap between the study of traditional classes and the study of ODL. By focusing on the transition of learning methods, we can get a more comprehensive view of how students' academic performance relates to different learning methods and may give suggestions to teachers and educators on how to be better prepared when facing a transition of learning methods in the future. On the other hand, China implements the largest scale of transition from a traditional class to ODL, around 291 million Chinese students turn to ODL during the pandemic, thus it would be a feasible choice to study the impact of ODL under the context of China.

2. Methods

2.1 Participants

Students in the class of 2022 ($N=338$) were recruited from a key public high school in China, who took a traditional in-person class in their twelfth grade first semester (# semester 1) and took ODL in twelfth grade second semester (# semester 2). Students with different prior academic performances were involved, and all of them took three mandatory courses: Chinese, English, and Mathematics. Besides mandatory courses, 151 students enrolled in Physics, 134 students enrolled in Chemistry, 59 students enrolled in Politics, and 46 students applied History. For each student, the final grade (x out of 150) of three mandatory courses in twelfth grade two semesters were recorded.

2.2 Descriptive Analysis

The research aims at the change of academic performance through the transition from a traditional class to ODL, the performance in the final exam of # semester 1 would be used to represent the student's prior academic performance, and the performance in the final exam of # semester 2 would be used to represent student's academic performance during ODL. To avoid including confound such as differences in difficulty between two exams, this research adapts rank instead of the score as the indicator for student's performance. For each student, the difference between #rank 1 and #rank 2 reflects the change in academic performance through the transition from a traditional class to ODL. The comparison would be applied to the three mandatory courses: Chinese, English, and Mathematics. To better illustrate the influence of ODL, the student's performance in eleventh grade (completely in-person) would be used as a control group reflecting students' change of performance during traditional class.

2.3 Statistical Analysis

Spearman and Pearson Correlation coefficient would be reported to show the correlation between 1. student's academic performance during traditional class and student's academic performance during ODL; 2. student's academic performance during traditional class and the change of student's academic performance through the transition from a traditional class to ODL. Scatter plot with prior academic performance (# rank 1) as x-axis and change of performance as y-axis (# rank 1 - # rank 2) would be plotted for three different subjects as well as the total score, the relation between academic performance during traditional class and student's academic performance during ODL would also be demonstrated. Following the above discussion, the research has two hypotheses:

H1: Students' prior academic performance during traditional class is positively correlated with students' academic performance during ODL.

H2: Students' prior academic performance is negatively correlated with the change in performance during the transition from a traditional class to ODL.

3. Results and Discussion

The descriptive data for the final exam in twelfth grade first & second semester are listed in the following table. Sample size, maximum, minimum, average and other statistical magnitude are included, a coefficient of variance smaller or equal to 0.15 indicates a small possibility to find abnormal value.

Table 1. Descriptive statistics for the final exam in twelfth grade first & second semester

Variables	Sample size	maximum	minimum	avg	std	variance	kurtosis	skewness	Coefficient of variance
#Semester 1 Chinese	338	123	48	98.34	8.886	78.967	2.784	-0.74	0.090
#Semester 1 Mathematics	338	141	35	111.743	12.11	146.655	4.76	-1.126	0.108
#Semester 1 English	338	124	37	96.627	12.62	159.263	2.064	-1.044	0.131
#Semester 1 Total	338	360.5	194.5	306.71	25.747	662.923	1.218	-0.8	0.084
#Semester 2 Chinese	338	123	71	97.831	8.335	69.48	0.152	-0.224	0.085
#Semester 2 Mathematics	338	147	55	117.024	14.259	203.323	1.6	-0.722	0.122
#Semester 2 English	338	127	42.5	92.441	14.207	201.841	0.191	-0.456	0.154
#Semester 2 Total	338	365.5	199.5	307.296	29.115	847.672	0.223	-0.566	0.095

The following scatter plots demonstrate the relationship between Student's prior academic performance during traditional class (x-axis) and student's academic performance during ODL (y-axis).

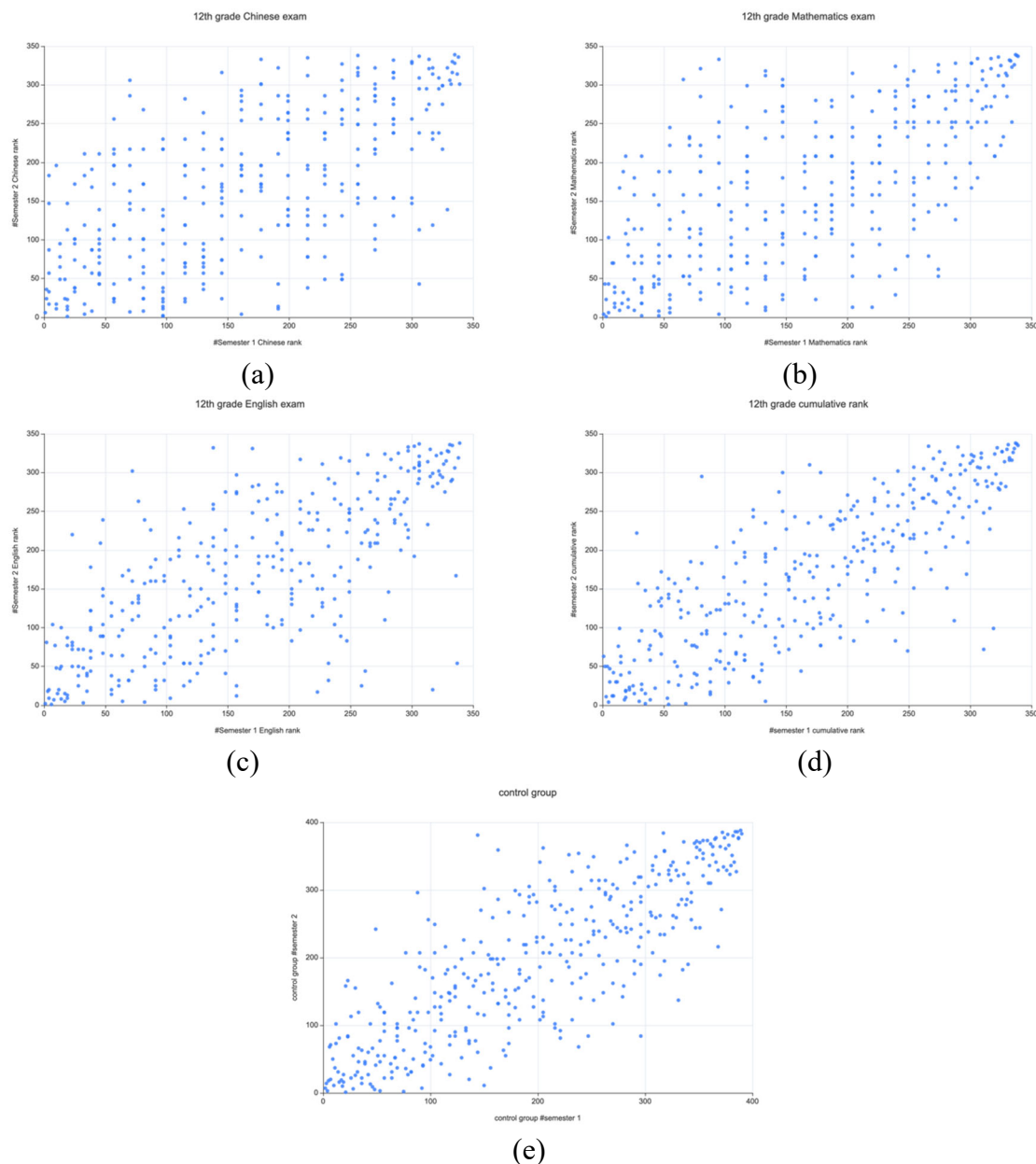


Fig. 1. Scatter plot for 12th and 11th grade first & second semester final exams

Fig. 1. (a) ~ Fig. 1. (d) demonstrates the final exam rank of 12th grade first and second semester for a different subject, Fig. 1. (e) demonstrates the cumulative final exam rank of 11th grade first and second semester.

The following table includes the statistical data and correlational coefficient running by SPSS, demonstrating the correlation between students' prior academic performance during traditional class and students' academic performance during ODL.

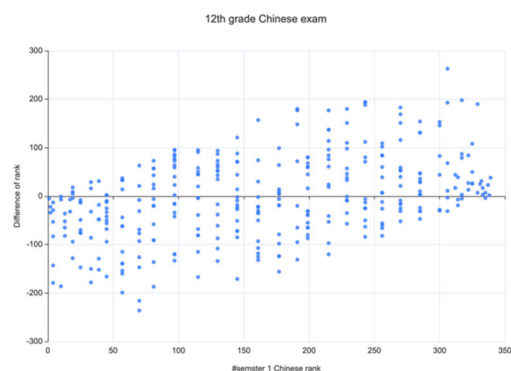
Table 2. Correlation coefficient between prior academic performance and academic performance during ODL

	Spearman correlational coefficient	p-value	Pearson correlational coefficient	p-value
Chinese rank #1 & Chinese rank #2	0.631	(0.000***)	0.633	(0.000***)
Mathematics rank #1 & Mathematics rank #2	0.639	(0.000***)	0.639	(0.000***)
English rank #1 & English rank #2	0.714	(0.000***)	0.713	(0.000***)
total rank #1 & total rank #2	0.803	(0.000***)	0.803	(0.000***)
total (11 th grade) rank #1 & total (11 th grade) rank #2	0.819	(0.000***)	0.819	(0.000***)

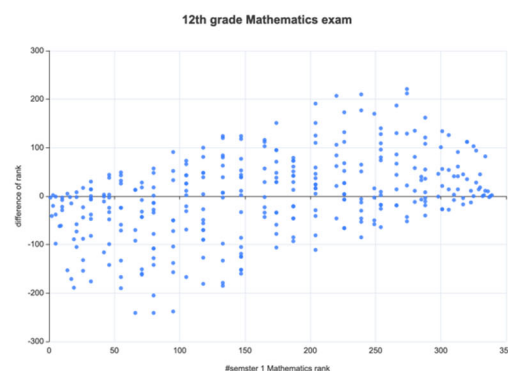
Note: ***, **, * represents 1%, 5%, 10%. Significance level

From the above data, Figure 1 demonstrates an overall positive correlation between Student's prior academic performance during traditional class and performance during ODL in Chinese, Mathematics, English, and cumulative final exam. Through calculating the Pearson correlational coefficient in Table 2, a moderate positive correlational coefficient is found in each dispersed subject (Chinese 0.633, English 0.639, Mathematics 0.713), and a strong positive correlational coefficient is found in the cumulative of different subjects (ODL 0.803, traditional class 0.819). Such a strong positive correlational coefficient indicates a positive linear relationship between students' prior cumulative exams performance and later cumulative exams performance. A linear regression (least square method) is applied for total (12th grade) rank #1 & total (12th grade) rank #2 ($rank2 = 33.694 + 0.799 * rank1$, $R^2 = 0.645$, $t = 5.336$, $p < 0.01$), and total (11th grade) rank #1 & total (11th grade) rank #2 ($rank2 = 33.245 + 0.819 * rank1$, $R^2 = 0.672$, $t = 5.062$, $p < 0.01$). The linear regression fitting indicates that prior academic performance represents by cumulative exam have a good prediction of the later academic performance in both traditional class and ODL context. The regression models for the two cases are very similar, R^2 around 0.65, represents a moderate satisfying fitting level. The previous finding from Huang and Fang shows that in traditional learning, choosing cumulative GPA as the only predictor variable is most appropriate in predicting a student's academic performance [9]. Which is consistent with the above result, and assists that prior cumulative exam rank would also be a good predictor for later academic performance during the transition from a traditional class to ODL.

The following scatter plots demonstrate the relationship between Student's prior academic performance during traditional class (x-axis) and student's change of performance during the transition from traditional class to ODL (y-axis).



(a)



(b)

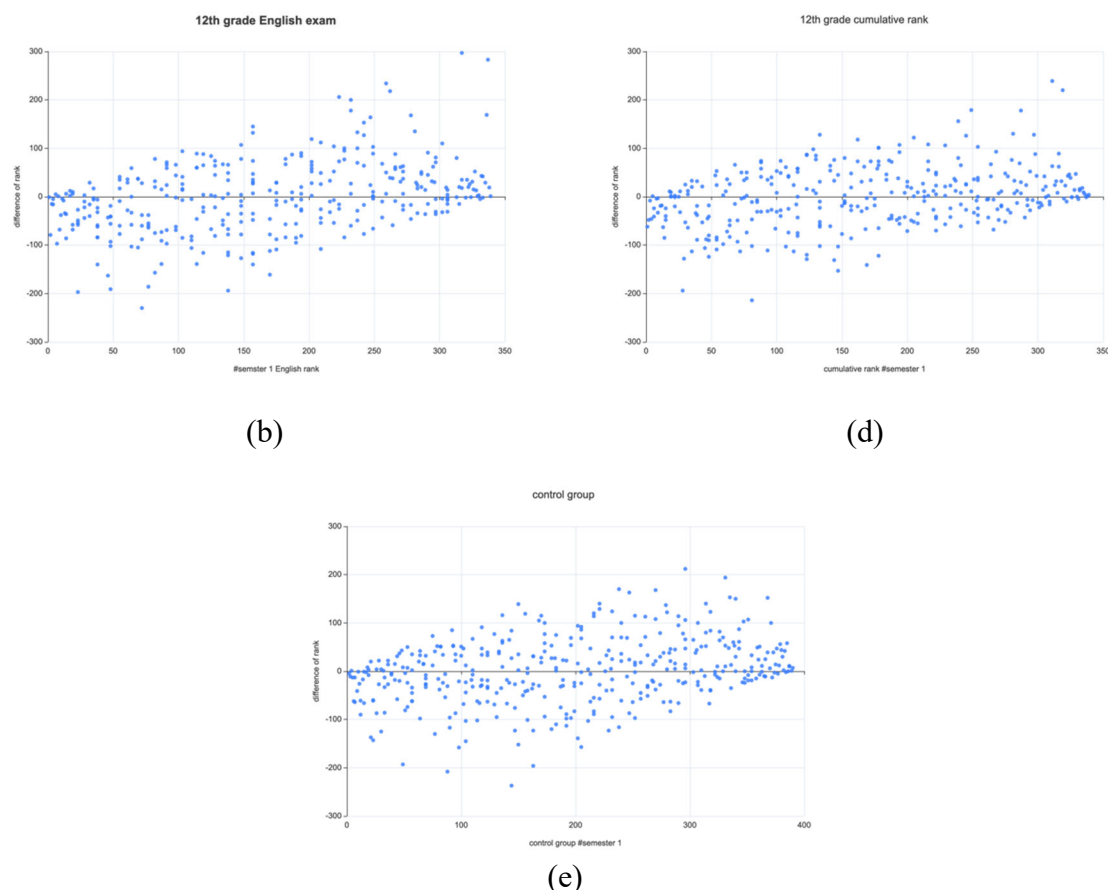


Fig. 2. Scatter plot for relation between prior academic performance and change of performance during the transition

Fig. 2. (a) ~ Fig. 1. (d) demonstrates the final exam rank of 12th grade first semester and the rank difference for corresponding subject compared to 12th grade second semester, Fig. 2. (e) demonstrates the cumulative final exam rank of 11th grade first semester and the rank difference compared to 11th grade second semester.

The following table includes the statistical data and correlational coefficient running by SPSS, demonstrate the correlation between student's prior academic performance during traditional class and the change of performance during the transition from traditional class to ODL.

Table 3. Correlation coefficient between prior academic performance and change of performance during the transition from traditional class to ODL

	Spearman correlational coefficient	p-value	Pearson correlational coefficient	p-value
Chinese rank #1 & Chinese rank difference	0.416	(0.000***)	0.428	(0.000***)
Mathematics rank #1 & Mathematics rank difference	0.423	(0.000***)	0.428	(0.000***)
English rank #1 & English rank difference	0.380	(0.000***)	0.385	(0.000***)
total rank #1 & total rank difference	0.298	(0.000***)	0.320	(0.000***)
total (11 th grade) rank #1 & total (11 th grade) rank difference	0.296	(0.000***)	0.301	(0.000***)

Note: ***, **, * represents 1%, 5%, 10%. Significance level

Figure 2 demonstrates an overall weak positive correlation between Student's prior academic performance during traditional class and change of performance during ODL in Chinese, Mathematics, English, and cumulative final exam. Through calculating the Pearson correlational coefficient in Table 3, a weak positive correlational coefficient is found in each dispersed subject and cumulative score (Chinese 0.428, English 0.428, Mathematics 0.358, ODL cumulative 0.320, traditional class cumulative 0.301). Though the correlation coefficient is not close to 1, the positive signal indicates that overall, the higher the prior academic performance, the easier for a student to get a lower rank in later exams, and it applies to both traditional class and ODL. The result agrees with the regression model in Table 4, for both regression models, the vertical intercept is positive (33.694, 33.245), and the slope is smaller than one (0.799, 0.819), which indicates the higher the prior cumulative rank, the harder to get a better ranking in later exams. The result is reasonable as students with higher rankings would have less room for making progress and vice versa.

4. Conclusion

The student's academic performance during ODL has been intensively analyzed, this research focuses on the impact of students' prior academic performance during the traditional in-person class to the later academic performance through the transition from a traditional class to ODL. Based on the grade of 338 students from the Class of 2022, descriptive statistics, visualizations, Spearman & Pearson correlational coefficient, and linear regression fitting are provided for students' prior academic achievement and their later academic achievement during ODL. The results show a strong positive linear relationship (Pearson correlational coefficient above 0.8) between students' prior academic achievement and later academic performance during ODL, prior academic performance represents by cumulative exam have a good prediction of the later academic performance in both traditional class and ODL context. Also, a weak positive correlation is found between students' prior academic performance during traditional class and the change of performance during the transition from a traditional class to ODL, a higher prior academic achievement indicates a higher likelihood for a student to get a lower rank in a later exam.

This research intends to discover the relationship between prior academic performance and later performance during the transition of class types. Though the data is statistically significant, plenty of limitations still could be improved. The participants are limited to one grade from one school, which introduces the teaching quality, school policies, and learning environment as potential confounds. Student demographic may also be an influential factor, gender, and personality traits such as agreeableness, conscientiousness, and openness has been proved to be influential to academic outcome during ODL, this research didn't include the student demographic to avoid the overwhelming complexity. Also, this research focuses on the high school education in the context of China, because high school education would be a good representation of Chinese systematic teaching. Future research may base on the present study to produce a more rigorous model for predicting academic performance during ODL, at the same time, explore the difference in academic performance between ODL and traditional classes.

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