

## **Institutional Effectiveness: Late Completion of the Quantitative Literacy Requirement in Non-Technical Fields is a Major Roadblock to Graduating**

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Completion of a Quantitative Literacy course with a grade of C or above is required to earn an undergraduate degree to demonstrate proficiency in Mathematics at Eastern Washington University (1, Catalog). Additionally, most of the non-technical majors offered at EWU require MATH107 as part of the curriculum. As we are researching the reasons why students do not graduate from EWU, we hypothesized that a late fulfillment of a Quantitative Literacy course is a major roadblock to students graduating in non-technical fields that require MATH107 ( $H_1$ ).

The null hypothesis was rejected, and we found that:

- students on average complete MATH107 a quarter before reaching Junior status, and half of the students completed the course while having 71 credits or more;
- students who complete the requirement before reaching Junior status are 59% more likely to graduate compared to students who reach Junior status without the requirement completion;
- and the odds of graduating for students who reach Senior status without the requirement completion are slim to none.

Based on our findings, we conclude that ensuring early completion of the requirement will set up students in non-technical fields for success more effectively.

### **Methodology**

We gathered data consisting of undergraduate students ( $n = 687$ ) in Cheney and Spokane campuses who started in Fall 2014, 2015, and 2016 without associate degrees in the following populations:

- freshmen with or without college credits,
- previous EWU running start students,
- and international freshmen.

Students' primary programs were in non-technical majors (2, a full list of majors can be found in the references) which require MATH107 to earn their degree. Nevertheless, since students can substitute the course with another Mathematics course or with a transferred course, we excluded the students who completed the requirement through other means. See Table 1 for Descriptive Statistics.

Table 1. Descriptive Statistics.

Variable	Frequency (n = 687)	
	n	%
Graduated	444	64.63
Quant. Literacy Completed (Pre-JR)	314	45.71
Quant. Literacy Completed (Pre-SR)	421	60.84
<b>Control Variables</b>		
Female	417	60.70
Age		
17-23	627	91.27
24 and older	60	8.73
GPA		
3.0 and less	253	36.83
3.0 - 3.5	270	39.30
3.5 - 4.0	164	23.87
Race		
Asian	17	2.47
Black	51	7.42
Hispanic	178	25.91
International	2	0.29
Native American	1	0.15
Pacific Islander	4	0.58
Two or More	53	7.71
Unknown	2	0.29
White	379	55.17

### Average Number of Credits Before Requirement Completion

By calculating the average number of credits students earned before the requirement completion, we found that students were completing MATH107 at the institution on average a quarter prior to reaching Junior status (see Table 2). Additionally, half of the students completed the course while having 71 credits or more.

Table 2. Number of Credits Earned Before Course Completion.

Course	Descriptive Statistics					
	n	Mean	SD	Q1	Median	Q3
MATH107	574	78.3	51.35	36.25	71	78.30

## Proportion Difference Tests

To determine whether late fulfillment of MATH107 is a roadblock for students to graduate, we performed two 2-Proportion Z Tests and compared the groups of students in the gathered population that completed the requirement prior to reaching Junior or Senior status with the groups that did not. Specifically, we tested whether the proportions of students who complete the requirement before reaching Junior or Senior status is greater than the proportions of students who did not.

The difference in proportions of students who graduated with the requirement completed prior to Junior status (0.7739) vs students who graduated without (0.5389) was statistically significant ( $p < 0.001$ ). The odds of students graduating with the requirement completed prior to Junior status was 70.78%, while the odds of students graduating without the requirement completed prior to Junior status was 14.42%. See Table 3 for the proportions.

*Table 3. Completion of the Requirement Prior to Reaching Junior Status.*

MATH107 Completed (Junior Status)	Graduated		Total
	Yes	No	
Before	243	71	314
After	201	172	373
Total	444	243	687

The difference in proportions of students who graduated with the requirement completed prior to Senior status (0.8301) vs students who graduated without (0.3606) was also statistically significant ( $p < 0.001$ ). See Table 4 for the proportions.

*Table 4. Completion of the Requirement Prior to Reaching Senior Status.*

MATH107 Completed (Senior Status)	Graduated		Total
	Yes	No	
Before	347	71	418
After	97	172	269
Total	444	243	687

## Logistic Regressions

To further test our hypothesis, we built two Logistic Regression models with *Graduated* as the dependent binary variable to determine the statistical significance of the completion of the requirement prior to Junior or Senior years as binary independent variables.

In the first regression model (see Table 5), we found that completion of the requirement prior to reaching Junior status is statistically significant ( $p < 0.05$ ) with the odds ratio being equal to 1.588. In other words, students who complete the requirement prior to reaching Junior status are 59% more likely to graduate than students who do not.

*Table 5. Logistic Regression with Quantitative Literacy Completion Prior to Junior Status as an Independent Variable*

Variable	Graduated					
	Estimate	Std. Error	z value	Pr(> z )		Odds Ratio
Intercept	9.731	1.036	9.391	0.000	***	16828
Quant. Literacy Completed (Pre-JR)	0.463	0.180	2.571	0.010	*	1.588
Control Variables						
Female	0.056	0.286	0.195	0.846		1.057
Age	-0.129	0.041	-3.120	0.002	**	0.879
GPA	2.925	0.224	13.044	0.000	***	18.628
Race						
Asian	-16.223	1.113	-14.569	0.000	***	0.000
Black	-15.424	0.964	-16.002	0.000	***	0.000
Hispanic	-15.492	0.722	-21.458	0.000	***	0.000
International	0.000	1.383	0.000	1.000		1.000
Pacific Islander	-15.926	1.267	-12.573	0.000	***	0.000
Two or More	-15.465	0.964	-16.042	0.000	***	0.000
Unknown	-15.928	1.962	-8.120	0.000	***	0.000
White	-15.299	0.581	-26.333	0.000	***	0.000

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

In the second regression model (see Table 6), we found that completion of the requirement prior to reaching Senior status is also statistically significant ( $p < 0.001$ ) with odds ratio being equal to 4.926, meaning that students who complete the requirement prior to reaching Senior status are 393% more likely to graduate than students who have to complete the requirement during their Senior year. However, having such high odds ratio also indicate that the odds of students who do not complete the requirement prior to reaching Senior status graduating are slim to none.

Table 6. Logistic Regression with Quantitative Literacy Completion Prior to Senior Status as an Independent Variable

Variable	Graduated					Odds Ratio
	Estimate	Std. Error	z value	Pr(> z )		
Intercept	10.727	1.425	7.530	0.000	***	45592
Quant. Literacy Completed (Pre-SR)	1.595	0.251	6.363	0.000	***	4.926
Control Variables						
Female	0.116	0.315	0.368	0.713		1.123
Age	-0.129	0.041	-3.168	0.002	**	0.879
GPA	2.585	0.268	9.651	0.000	***	13.262
Race						
Asian	-16.810	1.288	-13.048	0.000	***	0.000
Black	-15.987	1.152	-13.874	0.000	***	0.000
Hispanic	-16.286	0.965	-16.883	0.000	***	0.000
International	0.014	1.618	0.008	0.993		1.014
Pacific Islander	-16.705	1.549	-10.786	0.000	***	0.000
Two or More	-16.203	1.171	-13.834	0.000	***	0.000
Unknown	-16.450	2.469	-6.663	0.000	***	0.000
White	-15.976	1.007	-15.870	0.000	***	0.000

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

## References

1. Undergraduate Catalog. Link: <https://catalog.ewu.edu/undergraduate-degree/#mathcomproficienciestext>

2. **List of Majors:**

Addiction Studies, Anthropology, Studio Art, Children's Studies, Communication Studies, Criminal Justice, English as a Second Language, English Studies, Film, French, French with minor, Geography, Women's and Gender Studies, History with minor, History, Humanities, International Affairs, Interdisciplinary Studies, Interdisciplinary Liberal Arts, Interdisciplinary Studies, Journalism, Music, Philosophy, Philosophy with minor, Political Science, Political Science with minor, Psychology, Race and Culture Studies, Outdoor Recreation, Therapeutic Recreation, Recreation & Tourism Mgmt, Sociology, Social Work, Spanish, Spanish with minor