
# The Efficacy of the Math and English Placement Protocols

## Spring 2018

# Executive Summary

- During the fall of 2017, college English enrollment increased by 9% and College math enrollment increased by 15% since the fall of 2015.
- English saw an 8% increase in college English success rates and college math saw a 12% increase between the fall of 2015 and the fall of 2017.
- Developmental English and math pass rates remained statistically similar between the two fall years.
- High school GPA correlates the highest with LCCC GPA (*r*=.4).
- For the fall of 2017, high school GPA is the strongest predictor for all math and English course types except developmental English, which confirms last year's results.
- ACT English followed by McCann reading best predict developmental English success during the fall of 2017, which is similar to last year's results.
- ALEKS showed much stronger predictability of developmental math success during fall, 2017 as compared to the prior fall term.
- Students showed an average change in ALEKS score of -1.85% between the practice test and the proctored test.
- Years after high school positively correlates with LCCC GPA (*r*=.37), meaning as students get older, their GPAs increase at LCCC.
- Older students pass college and developmental math and English classes at higher rates than younger students.

# Background

During the 2016-2017 academic year, Laramie County Community College (LCCC) began using new tests to place students into college or developmental English or math courses (i.e. placement protocols). During the spring of 2016, these measures were tested to see if they resulted in improvements in placement outcomes. This report continues this by examining these measures for students enrolled during the fall of 2017.

Different measures are used to determine which entry or developmental level English or math course a student first attends at Laramie County Community College (LCCC). Figure 1 shows the protocol for English placement and Figure 2 shows the protocol for Math placement. As shown, English uses High School (HS) Grade Point Average (GPA), McCann Scores, and ACT Reading and Writing Scores to determine in which course a student should begin. Math placement is determined by GPA, Math ACT Score, or an ALEKS Math Placement Exam. Students may also transfer previous equivalent math credits.

This report updates this work for Fall, 2017 by exploring the enrollment trends, pass trends, and pass rates off developmental Math and English classes, and whether the math and English placement protocols resulted in proportionately larger numbers of students being placed into college-level math and English courses and as a result proportionately larger numbers of students passing those courses. After examining enrollment and pass trends, this study examines the predictors of college and developmental English and math given the different measures of placement, and thus tests the predictive validity of those measures. Next, this report explores the effects on English and math outcomes given the amount of time it has been since the student graduated from high school. Finally, this report tests the effects of the ALEKS tutoring on the ALEKS placement scores.

| High School Final Cumulative GPA | | |
|---|---|---|
| GPA | LCCC Course | |
| 3.0+ | ENGL 1010 | English I: Composition |

| | Reading Score | Writing Score | LCCC Course | |
|---|---|---|---|---|
| McCann Scores | 50-150 | 1 | DVST 0890 | Basic Skills Development |
| | 50-150 | 2-3 | ENGL 0810 | Fundamentals of Reading and Writing |
| | 50-85 | 4 | ENGL 0810 | Fundamentals of Reading and Writing |
| | | 5-6 | ENGL 0910 w/ ENGL 1010 | Literacy Enhancement for Composition I w/ English I: Composition |
| | 86-150 | 4 | ENGL 0910 w/ ENGL 1010 | Literacy Enhancement for Composition I w/ English I: Composition |
| | | 5-6 | ENGL 1010 | English I: Composition |
| ACT Scores | 21+ | 18+ | ENGL 1010 | English I: Composition |

Students who are not placed into college-level coursework via GPA or ACT scores (or previously earned college credit) should take the McCann College Success Exam for placement.

*Figure 1*. Placement of English classes using HS GPA, ACT (Reading and Writing), and McCann Scores.

| High School Final Cumulative GPA | | |
|---|---|---|
| GPA | LCCC Course | |
| 3.0+ | MATH 1510 | Technical Mathematics |
| | MATH 1010 | Problem Solving |
| | MATH 1400 | College Algebra |

| ALEKS Score | LCCC Course | | ACT Score |
|---|---|---|---|
| 0-13 | MATH 0900 | Pre-Algebra | |
| 14-29 | MATH 0960 | Integrated Statistics – Statway I | |
| | MATH 0970 | Integrated Problem Solving – Quantway I | |
| | MATH 0980 | Integrated College Algebra – Algebraway I | |
| | MATH 1510 | Technical Mathematics | |
| 30-45 | MATH 0990 | Integrated Pre-Calculus – Stemway I | |
| | MATH 1010 | Problem Solving | 19+ |
| 46-60 | MATH 1100 | Numbers and Operations for Elementary School Teachers | 22+ |
| | MATH 1400 | College Algebra | 22-23 |
| | STAT 2070 | Introductory Statistics for the Social Sciences | |
| 61-75 | MATH 1401 | Pre-Calculus | 22-23 |
| | MATH 1405 | Pre-Calculus Trigonometry | 24-26 |
| | MATH 1450 | Pre-Calculus Algebra/Trigonometry | 22-26 |
| | STAT 2010 | Statistical Concepts – Business | |
| | STAT 2050 | Fundamentals of Statistics | |
| 76-100 | MATH 2200 | Calculus I | 27+ |
| | MATH 2350 | Business Calculus I | 24-26 |
| | MATH 2355 | Mathematical Applications for Business | |

Students who are not placed into college-level coursework via GPA or ACT scores (or previously earned college credit) should take the ALEKS Exam for placement. ALEKS offers an initial assessment that can be completed at home and Prep and Learning Modules to refresh on lost knowledge.

*Figure 2*. Placement of Math classes using HS GPA, ACT Math, and ALEKS Scores.

# Methodology

CROA was used to sample all college math and English students from the fall 2015, fall 2016, and fall 2017 terms. Using CROA filters and custom-coded variables, the sample for the first part of this study was limited to students whose first college was LCCC, who were on their first year at LCCC (and therefore did not take any developmental or college classes at LCCC any prior terms) and students who were not taking college-level classes concurrently in a high school. The sample was also limited to degree-seeking students (full-time or part-time) who were enrolled in English 1010, Statistics 2070, Math 1010, Math 1400, or Math 1401 for college level students and Statistics 0260, Math 0960, Math 1000, Math 0970, Math 0980, Math 0990, Math 1390, Math 1380, English 810 and English 910 for developmental courses. These were thus captured into two four variables: a)College English, b) developmental English, c) college math, and D) developmental math. The sample for the age of high school degree included all degree students (first time or not first time).

# Results

The results section consists of six parts. First, it examines the enrollment and pass rates as they compare to the cohort, or the first-time, first-year, and degree-seeking students of that term. This therefore explores if there is an increase in enrollment, and if the proportion of students passing college level classes as compared to the cohort are different. Second, this study examines the boxplots and uses t-test to identify which placement measures (HS GPA, ACT, ALEKS, and/or McCann) differ between students who pass college and developmental English or math, and students who do not pass during the fall of 2017. Third, logistic regression is used to see which combination of placement scores best predicts college and developmental level course success during the fall of 2017. Finally, this examines the relationship between the age of a student's high school diploma, and his/her college performance. CROA was used to extract the data, Excel to screen and clean them, and R to run all statistical analyses.

# Overall Enrollment and Pass Rates in Comparison to Cohorts

As shown in Table 1, and figures 1 & 2, the percent of students who enrolled in both college English and College math increased when compared to Fall, 2015. English saw an 9% increase and math saw a 15% increase. The table and figure also show developmental pass and enrollment rates.

In addition, both college English and college math saw increases in pass rates. In the fall of 2015 around 31% of first-time, first-year degree seeking students passed college English, but in the fall of 2017, 39% passed. Likewise, in the fall of 2015, around 8% of first-time, first-year degree seeking students passed a college math class whereas 20% passed one in the fall of 2017. Because there was an increase in college course enrollment, when compared to their own cohort of first-time, first-year degree-seeking students, both English and math saw increases in the proportion of students who passed to their cohorts. Table 1 and Figures 2 and 3 also show the developmental pass numbers and rates.

*Table 1*

Enrollment and pass numbers of college and developmental English and math classes.

| Number | | | |
|---|---|---|---|
| **Category** | **Fall 2015** | **Fall 2016** | **Fall 2017** |
| **All New Students (First Time, First Term)** | 642 | 592 | 537 |
| **First Time, First Term Placed in Developmental English** | 126 | 103 | 65 |
| **First Time, First Term Passed Developmental English** | 81 | 65 | 45 |
| **First Time, First Term Placed in College English** | 282 | 305 | 286 |
| **First Time, First Term Passed College English** | 198 | 227 | 207 |
| **First Time, First Term Placed in Develepmental Math** | 248 | 129 | 121 |
| **First Time, First Term Passed Develepmental Math** | 145 | 78 | 77 |
| **First Time, First Term Placed in College Math** | 70 | 164 | 142 |
| **First Time, First Term Passed College Math** | 50 | 114 | 108 |

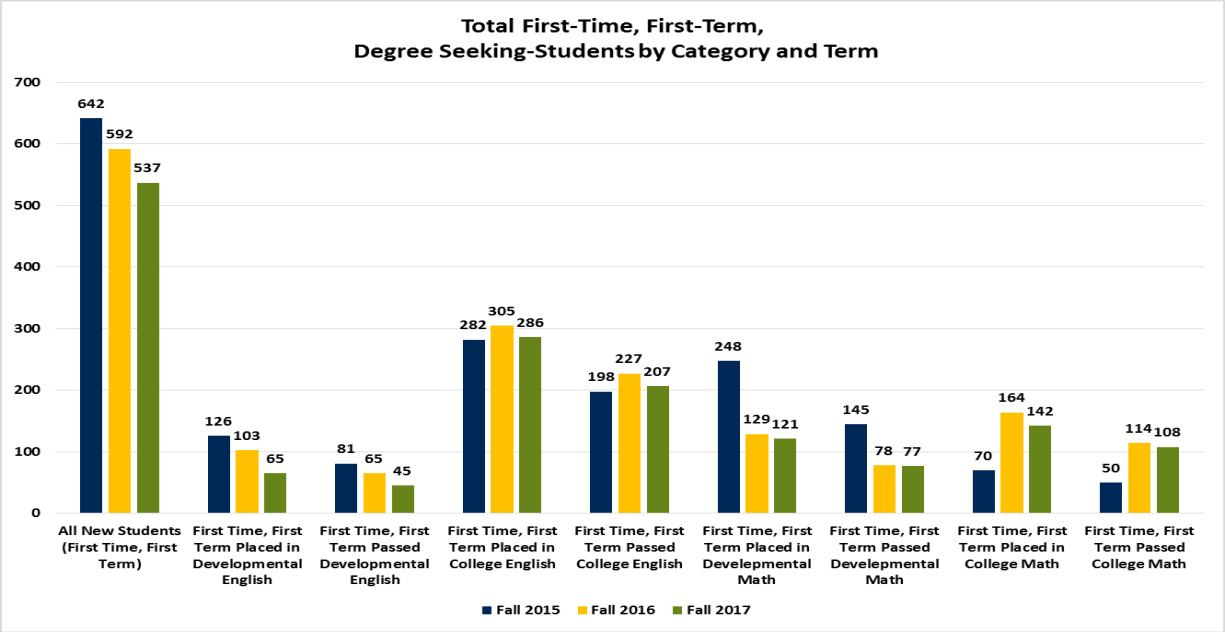


*Figure 2*. Total first-time, first-term, and degree-seeking students by category and term.

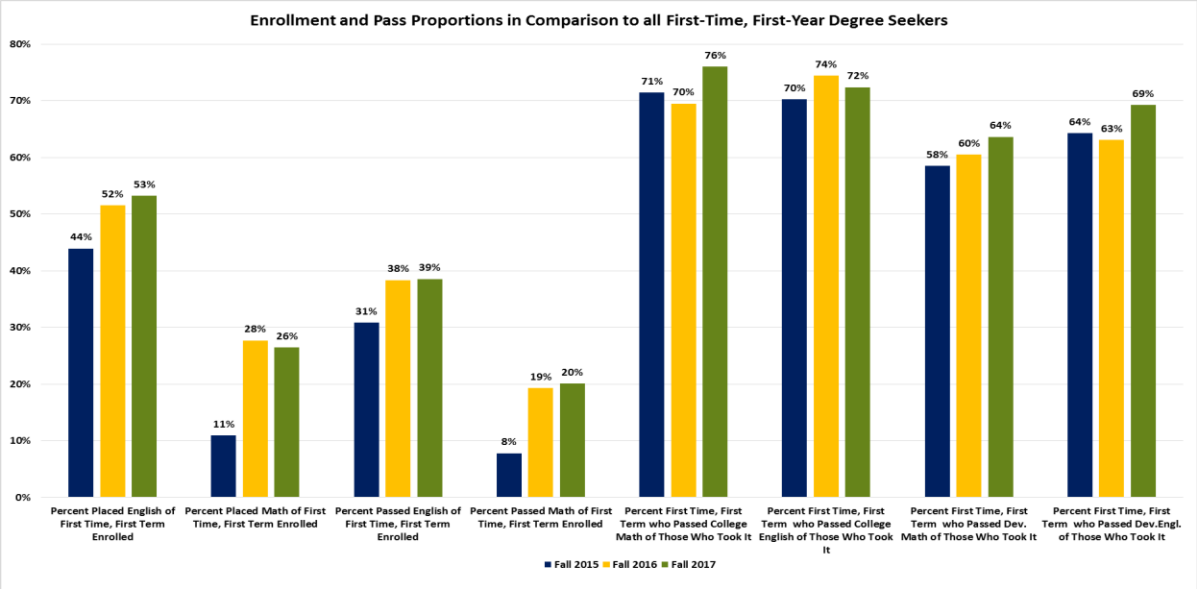


*Figure 3.* Percent of degree-seeking first time, first year students who were placed and who completed college English or math.

# Differences in Pass Rates Given Term

Analyses were conducted to examine the pass rates of college level courses between the three terms (15/FA, 16/FA, and 17/FA). As shown in Table 1 and figure 4, pass rates show slight volatility, but remained statistically constant. In fact, developmental courses showed increases in pass rates.

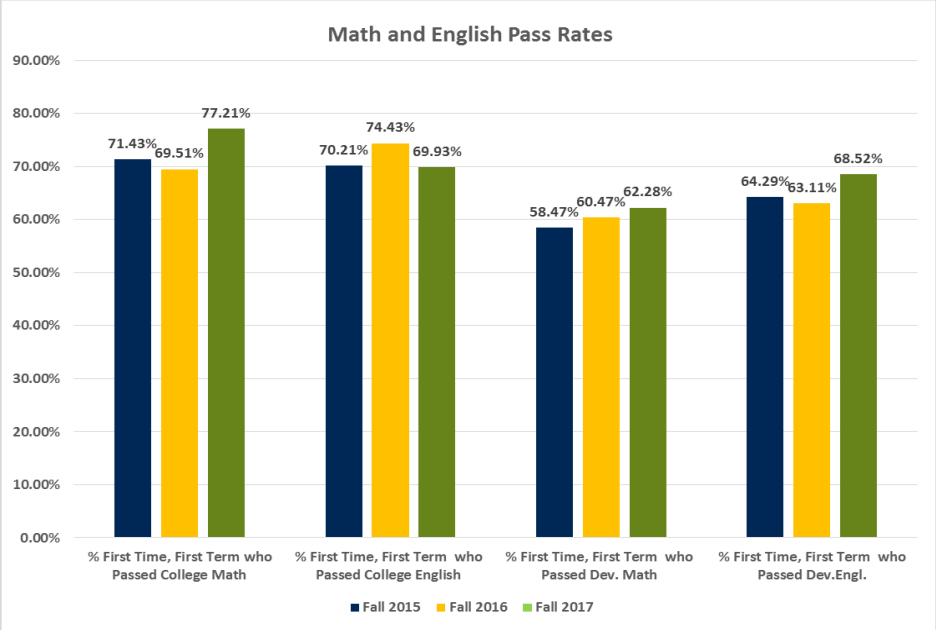


*Figure 4.* Percent of degree-seeking first time, first year students who passed college English or math by term.

# The Predictive Validity of Placement Measures

Measurement validity is defined as the extent to which measurement tools accurately and consistently measure what they purport to measure. One way to test measurement validity is to see the extent to which a measure predicts an outcome. In the case of High School Grade point average (GPA), ACT tests, ALEKS, and McCann, predictive validity would be strong if students who score higher on these tests earn consistently higher grades than students who score lower on these tests. Thus, the purpose of this section is to examine the predictive validity of these placement measures by using a variety of statistical tests. This year's report examines the outcomes of first-time, first year students from the fall of 2017. The results from Fall, 2015 and Fall, 2016 are on last year's report.

## The Correlation of the Placement Measures with LCCC Grades

First, all the placement measures were correlated with the students' college grade point averages (LCCC GPA). Even though a student's LCCC GPA does not represent a student's performance in a single course, it is useful to see how these measures correlate with overall college performance. Table 2 gives the Pearson Moment Product *r* values, and figures 5-11 give the scatterplots for each. The higher the |*r*| value (on a scale between -1 and 1), the stronger the correlation. As shown, the strongest correlate with LCCC GPA is high school GPA, followed by ALEKS, and then ACT Math. The other variables showed modest results. Since these correlations included students who took all the tests, their coefficients might be slightly lower. For example, as shown in Figure 5, when correlating high GPA with LCCC GPA alone, one gets $r = .42$, or a $R^2$ of .17. The $R^2$ values are also given for the variables in Figure 7 (ALEKS and LCCC GPA) and Figure 8 (ACT Math and LCCC GPA).

Given the distance from the line and the tightness of the dots, the scatterplots show that of all the placement measures, HS GPA shows the strongest predictability of LCCC GPA, confirming last year's findings as well as findings in the literature. However these results also provide support that the new protocol for proctoring ALEKS is much more effective than last year.

Table 2
*Correlation matrix of all the placement measures and LCCC GPA*

| | LCCC GPA | HS GPA | ACT Read | ACT Engl. | ACT Math | ALEKS | McCann R | McCann W |
|---|---|---|---|---|---|---|---|---|
| LCCC GPA | 1 | 0.35 | 0.14 | 0.17 | 0.24 | 0.29 | 0.14 | -0.01 |
| HS GPA | 0.35 | 1 | 0.28 | 0.28 | 0.34 | 0.25 | -0.04 | 0.02 |
| ACT Read | 0.14 | 0.28 | 1 | 0.17 | 0.1 | 0.05 | 0.15 | 0.13 |
| ACT Engl. | 0.17 | 0.28 | 0.17 | 1 | 0.35 | 0.29 | 0.35 | 0.19 |
| ACT Math | 0.24 | 0.34 | 0.1 | 0.35 | 1 | 0.56 | 0.33 | 0 |
| ALEKS | 0.29 | 0.25 | 0.05 | 0.29 | 0.56 | 1 | 0.31 | -0.07 |
| McCann R | 0.14 | -0.04 | 0.15 | 0.35 | 0.33 | 0.31 | 1 | 0.19 |
| McCann W | -0.01 | 0.02 | 0.13 | 0.19 | 0 | -0.07 | 0.19 | 1 |

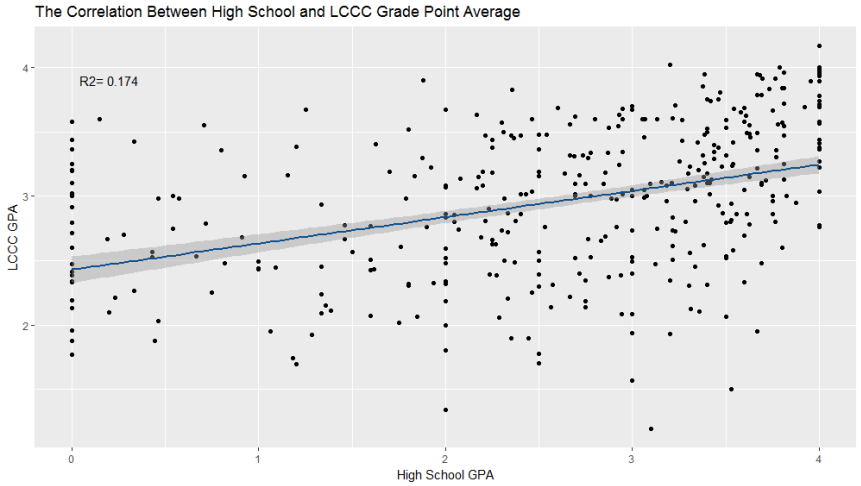


*Figure 5*. The correlation between LCCC GPA and HS GPA.

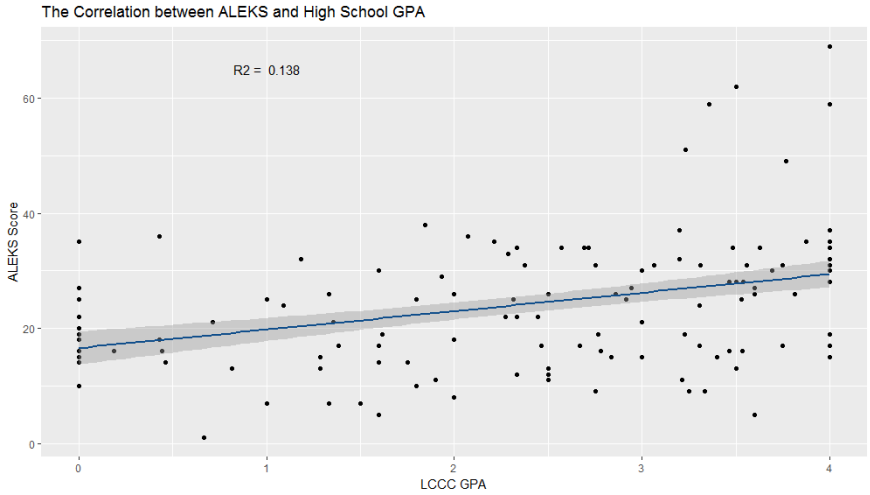


Figure 6. The correlation between LCCC GPA and ALEKS.

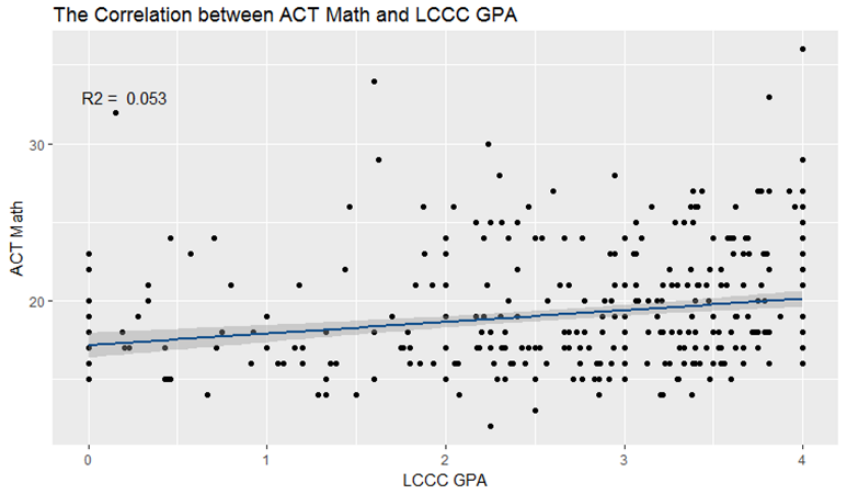


Figure 7. Correlation between LCCC GPA and ACT Math.

## Placement Measures and College Math and English Outcomes

T-test was used to see if there were statistically significant differences in placement scores between first time, first year students who passed college-level classes (A, B, C, or S), and students who did not pass that class (D, F, U, I, or W).

Students who passed college English had statistically higher High School GPAs than students who did not pass it ($p<.001$). The same was the case for students who passed college math ($p<.001$). Appendix A shows the test scores by course and grade for both college level and developmental. The table shows that high school GPA shows the best predictability of all the placement measures for first time, first year students taking college level courses in 17/FA. However, few students who took ALEKS, for example, took college level math. The next section will examine the placement measures for developmental courses.

Figures 8 through 11 show the boxplots of each measure for college English and math. The horizontal line in the middle of the box represents the median. The box consists of the area where most of the folks scored. The brackets show the range of values. For example, Figure 8, which shows high school GPA and college English, illustrates that a student who got an A in college English had a median High School GPA of about 3.3, but few had GPAs lower than 3.0. Boxplots that show a falling pattern from high grades to low grades are stronger placement measures than boxplots that remain constant, or that have higher values for lower grades.

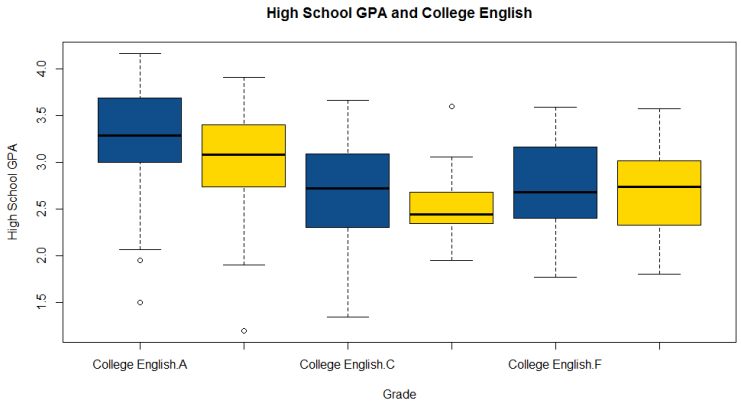


*Figure 8*. Boxplot showing the relationship between HS GPA and the grade earned in college English.

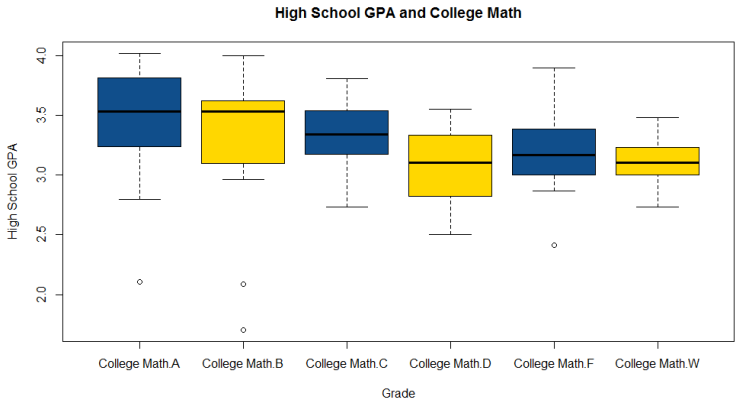


*Figure 9*. Boxplot showing the relationship between HS GPA and the grade earned in college math.

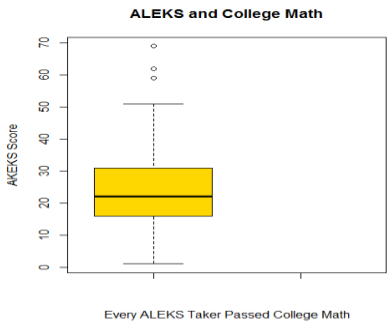


*Figure 10*. Boxplot showing the range of ALEKS scores of college math students. Every student who took ALEKS and was placed into college math passed (n=6).

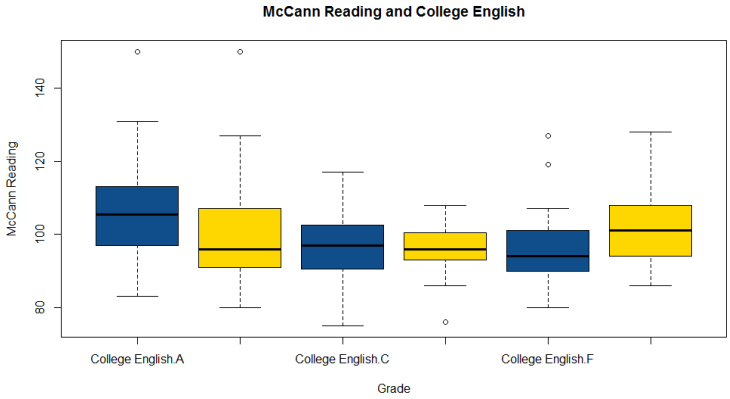


*Figure 11*. Boxplot showing the relationship between McCann Reading and the grade earned in college English.

## Predicting Pass Rates of College Level Classes Using Placement Measures

R was used to formulate a logistic regression model to predict passing college level English given scores on HS GPA and McCann reading, the two strongest measures found from the t-tests. Results indicate that HS GPA shows the most predictability in the model ($p$=.06) The *McFadden Pseudo* $R^2$ of .04 indicates a poorly fitted model. Thus, another logistic regression model was run with just high school GPA as the sole predictor. Removing McCann from the model increased the *Pseudo* $R^2$ to .07, and the model was significant. However, the results indicate that while high school GPA predicts outcomes better than the other measures, there are a lot of unknown extraneous variables. A separate model only using McCann Reading as a predictor was not significant. Table 4 shows the increase in probability of passing college English given high school GPA.

*Table 3*
Model of HS GPA and McCann on College English.

| | *B* | *St. Error* | *Wald* | *P* |
|---|---|---|---|---|
| **(Intercept)** | -3.83 | 2.11 | -1.82 | 0.07 |
| **HS GPA** | 0.89 | 0.47 | 1.87 | 0.06 |
| **McCann Reading** | 0.02 | 0.02 | 1.41 | 0.16 |

Table 4
*Probability of passing college English classes by high school grade point*

| High School GPA | | |
|---|---|---|
| Grade Point | Chance of Passing | St. Error |
| 1 | 24.32% | 9.28% |
| 1.5 | 36.90% | 8.77% |
| 2 | 51.54% | 6.43% |
| 2.5 | 65.93% | 3.71% |
| 3 | 77.88% | 2.72% |
| 3.4 | 85.04% | 2.83% |
| 4 | 92.10% | 2.62% |

R was also used to conduct logistic regression to test the combination of high school GPA and ACT Math on predicting college math performance. ALEKS was not used because of sample size. Table 5 shows that of the two, high school GPA shows the most predictability of passing college math. This model fit better than the English model with a *Psuedo-$R^2$* of .14. When run as separate predictors in two different models, high school GPA was statistically significant ($p$<.001, *Psuedo-$R^2$*=.11), but ACT Math was not ($p$=.28). Table 6 shows the increase in probability of passing college math given high school GPA. Higher standard errors make for less accurate predictability. It's interesting to note that high and low grades have more accurate predictability than grades in the C range.

*Table 5*
Model summary of HS GPA and ACT Math as a predictor of college math

| | *B* | *St. Error* | *Wald* | *P* |
|---|---|---|---|---|
| **(Intercept)** | -8.27 | 2.70 | -3.07 | <.001 |
| **HS GPA** | 2.48 | 0.67 | 3.72 | <.001 |
| **ACT Math** | 0.06 | 0.07 | 0.96 | 0.34 |

Table 6
*Probability of passing college math classes by high school grade point*

| High School GPA | | |
|---|---|---|
| Grade Point | Chance of Passing | St. Error |
| 1 | 2.87% | 3.50% |
| 1.5 | 7.61% | 6.90% |
| 2 | 18.65% | 10.85% |
| 2.5 | 38.96% | 10.90% |
| 3 | 63.99% | 5.67% |
| 3.4 | 80.12% | 3.58% |
| 4 | 93.23% | 2.95% |

## Placement Measures and Developmental Math and English Outcomes

R was also used to conduct t-tests between developmental course success and placement test score. For developmental English, surprisingly, high school GPA was not statistically significantly different for students who passed and students who did not. However, The Appendix shows the differences in GPA were about .12 grade points. Developmental English students who passed had statistically higher ACT English scores ($p$=.02), and McCann Reading scores ($p$=.02) than those who did not pass it. ACT Reading and McCann Writing did not show differences in score. For developmental math, students who passed these math classes had higher high school GPAs ($p$=.004). The other differences were not statistically significantly different. However, ALEKs had a low non-significant value of $p$=.12. The distribution of scores by grade earned in each class is shown on the table in the Appendix.

Figures 12-16 show the boxplots for each of these different placement measures for developmental students. The interpretation is the same as it is for college classes. Higher grades should have boxplots that float at higher levels. Non-significant placement tests have boxes that overlap a lot.

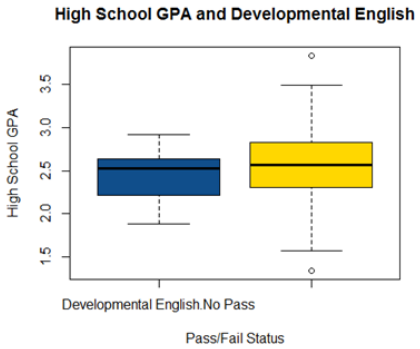


*Figure 12*. Boxplot showing the relationship between HS GPA and developmental English success.

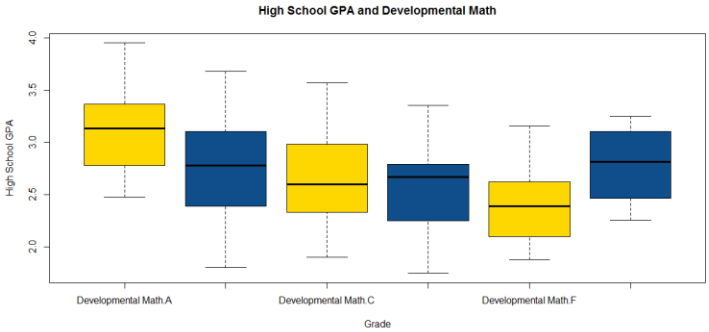


*Figure 13*. Boxplot showing the relationship between HS GPA and the grade earned in developmental math.

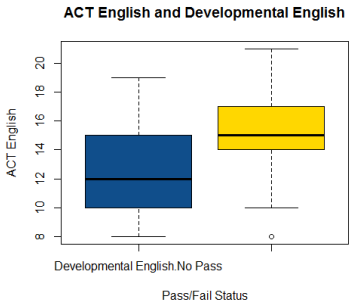


*Figure 14*. Boxplot showing the relationship between ACT English and developmental English.

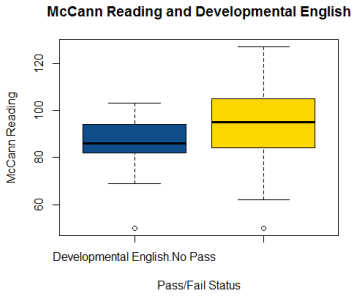


*Figure 15*. Boxplot showing the relationship between McCann Reading and the grade earned in developmental English.

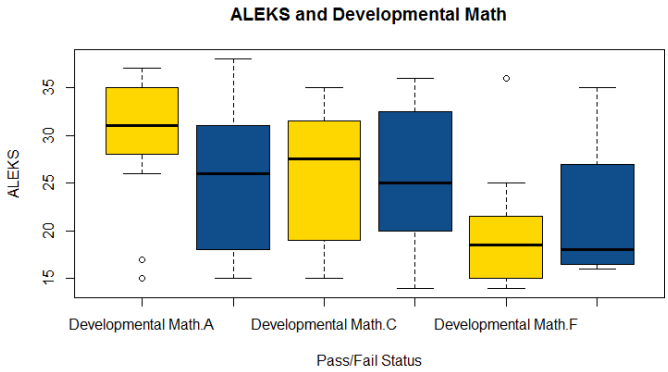


*Figure 16*. Boxplot showing the relationship between ALEKS and the grade earned in developmental math.

## Predicting Pass Rates of Developmental Level Classes Using Placement Measures

Logistic regression models were formulated on R to predict passing college level English and math. The English model used High School GPA, ACT English, and McCann Reading. The Math model used high school GPA and ALEKS.

The developmental English model showed no significant predictors. Therefore, high school GPA was removed from the model due to its low significance in the t-test as well as its low beta weight in the model. The resulting model only included McCann Reading and ACT English. This model yielded no significant predictors. Table 5 gives the first model's summary.

Table 5
*Model summary of HS GPA, ACT English, and McCann Reading as predictors of developmental English*

| | *B* | *St. Error* | *Wald* | *P* |
|---|---|---|---|---|
| **(Intercept)** | -2.71 | 3.31 | -0.82 | 0.41 |
| **HS GPA** | -0.24 | 1.10 | 0.22 | 0.82 |
| **ACT English** | 0.18 | 0.17 | 1.07 | 0.28 |
| **McCann Reading** | 0.02 | 0.03 | 0.48 | 0.63 |

A third model was run only to include ACT English and this model yielded a statistically significant result ($p$=.02, *Pseudo* $R^2$ =.12). A final model only including McCann reading also yielded a statistically significant result ($p$=.05, Pseudo $R^2$= .059). Both results confirm the t-tests. They also suggest, that for developmental level students, ACT English is the best predictor followed by McCann Reading. However, neither measure explains more than 12% of the variance. Table 5 shows the increase in probability of passing developmental classes given these scores. It is important to consider the standard of error when interpreting these. High standard errors make less accurate predictions. It is also interesting to note that the higher a student scores, in general, the more accurate the score predicts his/her chances of passing developmental English.

Table 6
*Probability of passing developmental English classes by score*

| McCann Reading | | |
|---|---|---|
| Score | Chance of Passing | St. Error |
| 50 | 28.92% | 17.76% |
| 60 | 37.86% | 15.84% |
| 70 | 47.71% | 12.36% |
| 80 | 57.74% | 8.54% |
| 90 | 67.18% | 6.39% |
| 100 | 75.40% | 6.69% |
| 110 | 82.11% | 7.51% |
| 120 | 87.30% | 7.66% |
| **ACT English** | | |
| Score | Chance of Passing | St. Error |
| 15 | 74.29% | 7.54% |
| 20 | 91.90% | 6.26% |
| 25 | 97.80% | 3.02% |
| 30 | 99.43% | 1.13% |
| 35 | 99.85% | 0.38% |

The developmental math model that included ACT Math and GPA showed no significant predictors, the the $p$ values were close to the .05 cutoff. Table 7 shows this model summary. ALEKS and high school GPA were run as separate models and both were found to be statistically significant predictors (high school GPA ($p$=.007, *Pseudo* $R^2$= .06), ALEKS ($p$=.004, *Pseudo* $R^2$= .09)). As shown on table 7, as scores increase, the probability of passing developmental math increases. However, these probabilities are less accurate predictions with higher standard error values.

Table 7
*Model summary of HS GPA, and ALEKS as predictors of developmental math.*

| | *B* | *St. Error* | *Wald* | *P* |
|---|---|---|---|---|
| **(Intercept)** | -4.04 | 1.91 | -2.11 | <.001 |
| **HS GPA** | 1.19 | 0.71 | 1.67 | 0.09 |
| **ALEKS** | 0.07 | 0.04 | 1.83 | 0.07 |

Table 8
*Probability of passing developmental math classes by score*

| High School GPA | | |
|---|---|---|
| Grade Point | Chance of Passing | St. Error |
| 1 | 18.37% | 11.99% |
| 1.5 | 30.00% | 12.01% |
| 2 | 44.96% | 8.90% |
| 2.5 | 60.88% | 5.12% |
| 3 | 74.78% | 5.25% |
| 3.4 | 83.24% | 6.00% |
| 4 | 91.50% | 5.41% |
| **ALEKS** | | |
| Score | Chance of Passing | St. Error |
| 10 | 31.35% | 11.44% |
| 20 | 55.43% | 6.84% |
| 30 | 77.21% | 6.20% |
| 40 | 90.22% | 5.75% |
| 50 | 96.17% | 3.64% |
| 60 | 98.56% | 1.90% |
| 70 | 99.47% | 0.90% |

## The change of ALEKS scores between Practice Tests and Placement Tests

The current protocol with ALEKS asks students to take a practice ALEKS test at their leisure, then receive three hours of tutoring, followed by a proctored ALEKS exam in the LCCC testing center. Therefore, the purpose of this section is to report on change of scores between the practice test and the proctored test.

The data were obtained from the testing center and included students who took it between April, 2017 and October, 2017. A paired-samples t-test was conducted to see if there was a statistically significant difference in test scores between the practice test and the proctored test. As shown in Table 9, even though the difference was found to be statistically significant ($p$=.011), the difference in score was small and also negative. On average, students scored -1.85% lower on the placement test than on the practice test. The high standard deviations indicate much variation in scores. ALEKS scores are reported as percent correct.

Table 9
*Means and standard deviations of practice and placement ALEKS scores*

| | *Mean* | *Std. Dev* |
|---|---|---|
| **Practice ALEKS** | 26.65% | 16.00% |
| **Placement ALEKS** | 24.80% | 13.00% |

Figure 17 shows the distribution (histogram) of the change in scores in ALEKS between the practice test and the placement test. These scores were calculated by subtracting the practice scores from the placement scores. As shown, many students scored significantly lower on the placement test than on the practice test, but just under half of those taking ALEKS also scored higher.

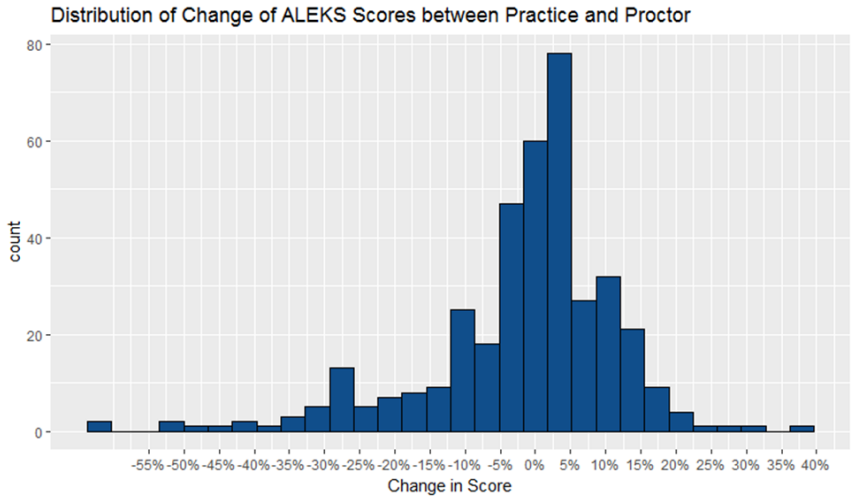


Figure 17. Distribution of changes in ALEKS scores between practice and placement.

# Years after High School, Placement, and College Success

Since students come to LCCC at different times in their lives, this study also sought to measure the effects of the amount of time since a student finished high school on his or her performance at LCCC. To conduct this analysis, every degree-seeking undergraduate student from the fall of 2017 with a high school degree date on record was sampled (*n*= 1,673). A variable was coded to calculate the time since their graduation date by computing the number of days between the 17/FA start date and the students' high school graduating date and dividing that by 365.25 ((StartDate-GradDate)/365.25)). This produced a number in years. A categorical variable was then coded as: a) Five years or less, b) Six to ten years, and c) More than ten years. The dataset also included student LCCC cumulative GPA and course performance including developmental and non-developmental courses

## The Relationship between Years since High School and GPA

Bivariate correlation was run to see the relationship between the years since a person graduated and high school GPA. Figure 18 gives the scatterplot. The Pearson's Moment Product $r$ = .32, indicating a moderate to low correlation between LCCC GPA and time since high school. This suggests that as students get older, their LCCC GPAs increase.

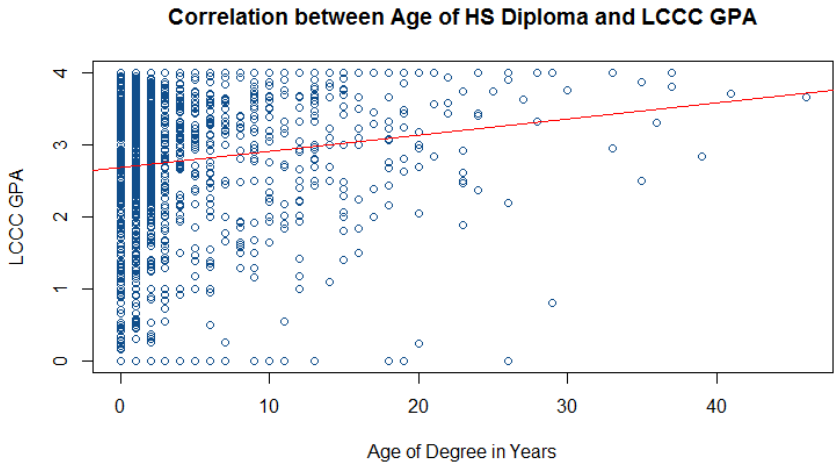


*Figure 18*. Scatterplot of Age of High School Degree and LCCC GPA.

Analysis of variance was used to test the difference in age of diploma category and LCCC GPA. The model was found to be statistically significant. Further analyses revealed a linear relationship between years since high school and overall LCCC performance. In short, older students tend to earn higher GPAs than younger students. The means plot is shown on figure 19. Table 11 shows the number, means, and standard deviations. It is worth noting that the largest group consisted of younger students. In addition, higher standard deviations indicate that the mean is less representative of the group.

Table 10
Number, means, and standard deviations of LCCC GPA by age group

| Age Category | N | Average GPA | Standard Dev. |
|---|---|---|---|
| More than 10 Years | 178 | 3.06 | 0.96 |
| 5 to 10 Years | 221 | 2.92 | 1.03 |
| Less than 5 Years | 1274 | 2.71 | 1.02 |

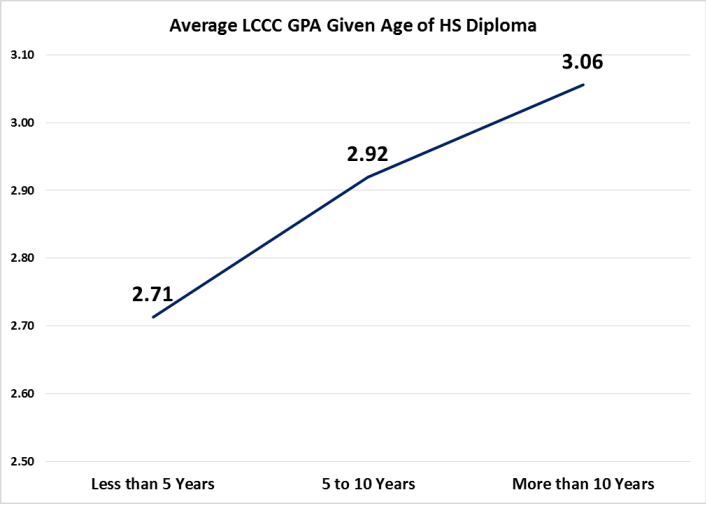


Figure 19. Means plot of average GPA given age category.

Analysis of covariance was used to see there was a difference in LCCC GPA given age of diploma while holding high school grades constant. In other words, if a student just out of high school has a B average, is that student's LCCC GPA likely to be different than a student who was longer out of high school but also had a B average in high school? ANCOVA is able to analyze this. Results indicate that when holding high school grades constant, on average, older students are more likely to earn higher grades at LCCC in all categories. Tables 11 and 12 show the results. Though few students in all categories had "A" averages, every other category shows older students doing better at LCCC within each grade category. Figure 20 gives a boxplot of these results. The boxplot shows that older students have higher medians across all high school grade categories.

*Table 11*

The number of students by years since high school and high school grade category

| Age of Diploma | A | B | C | F or D | Total |
|---|---|---|---|---|---|
| 0 to 4.9 Years | 25 | 702 | 515 | 32 | 1274 |
| 5 to 10 Years | 2 | 101 | 103 | 15 | 221 |
| More than 10 Years | 1 | 60 | 105 | 12 | 178 |
| **Grand Total** | **28** | **863** | **723** | **59** | **1673** |

*Table 12*

Mean and standard deviation LCCC GPA by years since high school, and high school grade category

| | Diploma Age | 0 to 4.9 Years | 5 to 10 Years | More than 10 Years | Grand Total |
|---|---|---|---|---|---|
| A | Average | 3.71 | 3.90 | 4.00 | **3.73** |
| | St. Dev. | 0.41 | 0.14 | 0.00 | **0.39** |
| B | Average | 2.97 | 3.22 | 3.40 | **3.03** |
| | St. Dev. | 0.94 | 0.79 | 0.84 | **0.92** |
| C | Average | 2.37 | 2.77 | 2.87 | **2.50** |
| | St. Dev. | 0.99 | 1.04 | 1.01 | **1.02** |
| F or D | Average | 1.83 | 1.78 | 2.92 | **2.04** |
| | St. Dev. | 1.17 | 1.42 | 0.69 | **1.23** |
| Total | Average | **2.71** | **2.92** | **3.06** | **2.78** |
| | St. Dev. | **1.02** | **1.03** | **0.96** | **1.02** |

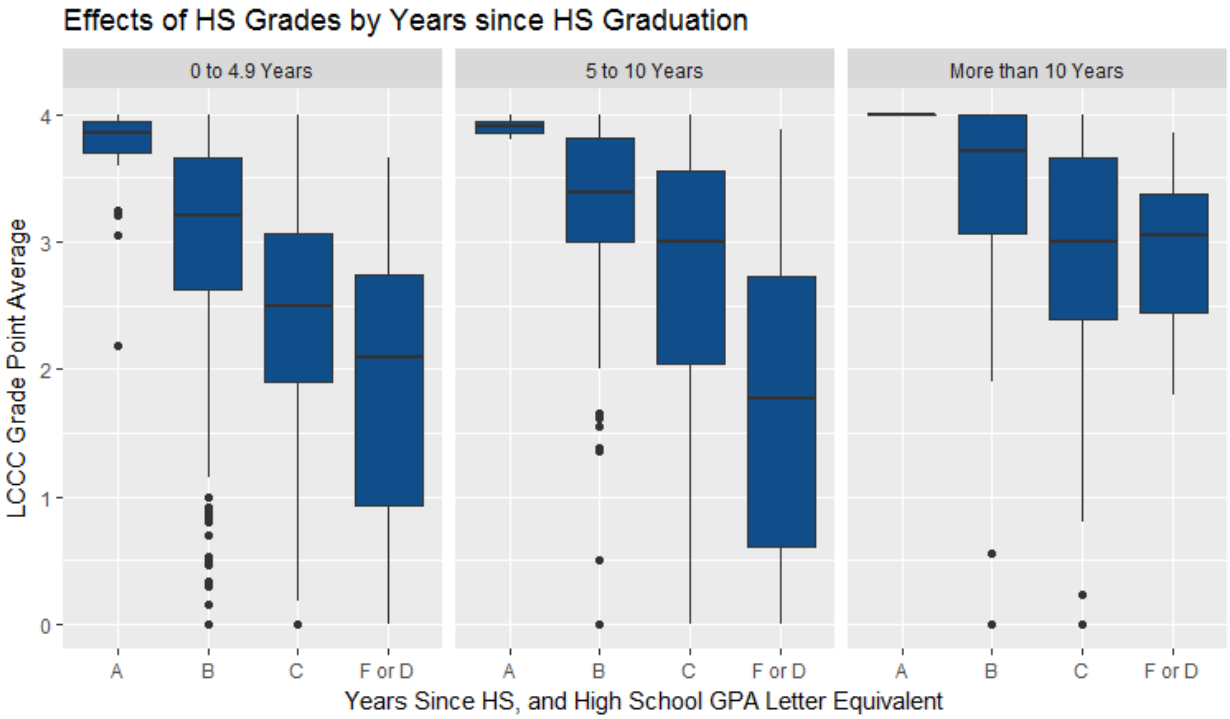


*Figure 20*. Box and whisker plot showing LCCC GPA performance given high school grade category and age of high school diploma.

Finally, the pass rates of college and developmental courses were examined by age category. In general, as students get older, they have a higher probability of passing college and developmental classes. Table 13 shows the numbers of students by age category, course, and pass/not pass status and the percent who passed given their age categories. It is important to consider the large differences in sample size between groups. Students more recently out of high school made up 79.28% of all the students who take developmental and college level math and English classes.

*Table 13*
Age and pass status by course

| Course/Age Category | Number Did Not Pass | Percent Did Not Pass | Number Passed | Percent Passed | Overall |
|---|---|---|---|---|---|
| **College English** | **141** | **30.26%** | **325** | **69.74%** | **466** |
| Less than 5 Years | 127 | 32.65% | 262 | 67.35% | 389 |
| 5 to 10 Years | 8 | 20.00% | 32 | 80.00% | 40 |
| More than 10 Years | 6 | 16.22% | 31 | 83.78% | 37 |
| **College Math** | **107** | **30.14%** | **248** | **69.86%** | **355** |
| Less than 5 Years | 95 | 30.84% | 213 | 69.16% | 308 |
| 5 to 10 Years | 7 | 24.14% | 22 | 75.86% | 29 |
| More than 10 Years | 5 | 27.78% | 13 | 72.22% | 18 |
| **Developmental English** | **31** | **27.68%** | **81** | **72.32%** | **112** |
| Less than 5 Years | 26 | 28.89% | 64 | 71.11% | 90 |
| 5 to 10 Years | 2 | 33.33% | 4 | 66.67% | 6 |
| More than 10 Years | 3 | 18.75% | 13 | 81.25% | 16 |
| **Developmental Math** | **168** | **44.21%** | **212** | **55.79%** | **380** |
| Less than 5 Years | 123 | 48.43% | 131 | 51.57% | 254 |
| 5 to 10 Years | 26 | 35.14% | 48 | 64.86% | 74 |
| More than 10 Years | 19 | 36.54% | 33 | 63.46% | 52 |
| **Grand Total** | **447** | **34.04%** | **866** | **65.96%** | **1313** |

These results suggest that a student's success in these courses is less statistically related to their time since high school and related to other factors. Things such as executive function, grit, and personality traits might explain success better than time since high school.

# Conclusion

Since using the placement protocol, LCCC has seen an increase in the proportion of first-time, first-year students who pass college level math and science classes. In addition, developmental course pass rates have remained statistically equal to previous years. This indicates that the past two years have seen a higher proportion of students get through the college level courses.

The strongest predictor of college level success remains high school GPA. This metric also is the strongest predictor of developmental math, but not so much for developmental English. For those courses, ACT English followed by McCann showed the strongest statistical evidence. However, it should be noted that though these placement tools showed the best evidence in comparison to each other, they are by no means perfectly precise. The overall correlational values and coefficients indicate that there is a lot of error. However, they are the best tools that we have.

ALEK's performance was much better this year. Even though there was a lot of variation in score, in general, median and mean ALEKS scores decrease as developmental math grades decrease. Few students who took ALEKS also took college math courses, so it was impossible to predict college math performance or grade given ALEKS. Nonetheless, the results indicate that the assessment is slightly better than ACT Math in terms of predicting developmental math performance. In addition, students scored, on average, 1.85% lower on the placement ALEKS as compared to the practice test. One explanation for this might be the conditions under which they take both tests.

The correlation between years since high school diploma and LCCC GPA was moderate to low. The average GPA of students increases as they get older. When examining college and developmental level courses, the same pattern emerges. Older students tend to do better. However, the number of students who have been away from high school more than five years is much lower than younger students.

Finally, all the results of this study, even for the best measures at LCCC, might be considered weak or moderate. The placement measures give information to help place students, but the low coefficients and correlations are a reminder that many other factors influence student success in college and developmental courses.

*Appendix*

| Course Type | N of HS GPA | Average | St. Dev. |
|---|---|---|---|
| **College English** | **270** | **2.94** | **0.56** |
| A | 73 | 3.25 | 0.54 |
| B | 87 | 3.02 | 0.51 |
| C | 42 | 2.70 | 0.54 |
| D | 15 | 2.53 | 0.42 |
| F | 43 | 2.72 | 0.48 |
| W | 10 | 2.67 | 0.54 |
| **College Math** | **146** | **3.35** | **0.41** |
| A | 47 | 3.49 | 0.39 |
| B | 37 | 3.39 | 0.46 |
| C | 27 | 3.36 | 0.25 |
| D | 12 | 3.07 | 0.35 |
| F | 13 | 3.18 | 0.36 |
| W | 9 | 3.14 | 0.23 |
| **Developmental English** | **59** | **2.53** | **0.43** |
| S | 43 | 2.57 | 0.47 |
| U | 14 | 2.43 | 0.32 |
| W | 2 | 2.53 | 0.28 |
| **Developmental Math** | **110** | **2.70** | **0.47** |
| A | 17 | 3.12 | 0.45 |
| B | 25 | 2.76 | 0.46 |
| C | 30 | 2.61 | 0.40 |
| D | 11 | 2.56 | 0.48 |
| F | 19 | 2.40 | 0.37 |
| W | 8 | 2.78 | 0.37 |
| **Grand Total** | **585** | **2.96** | **0.56** |
| Course Type | N of ACT Engl | Average | St. Dev. |
| **College English** | **219** | **19.33** | **4.71** |
| A | 59 | 20.86 | 4.73 |
| B | 68 | 18.97 | 4.83 |
| C | 31 | 17.52 | 4.18 |
| D | 14 | 18.14 | 4.09 |
| F | 42 | 19.36 | 4.63 |
| W | 5 | 20.40 | 4.16 |
| **Developmental English** | **42** | **14.55** | **3.34** |
| S | 29 | 15.38 | 2.99 |
| U | 13 | 12.69 | 3.45 |
| W | | | |
| **Grand Total** | **261** | **18.56** | **4.84** |
| Course Type | N of ACT Math | Average | St. Dev. |
| **College Math** | **128** | **20.80** | **3.44** |
| A | 44 | 21.34 | 3.24 |
| B | 32 | 20.94 | 3.18 |
| C | 21 | 20.33 | 3.99 |
| D | 11 | 22.18 | 3.37 |
| F | 12 | 20.33 | 3.17 |
| W | 7 | 17.57 | 3.15 |
| (blank) | 1 | 16.00 | #DIV/0! |
| **Developmental Math** | **91** | **17.20** | **2.04** |
| A | 11 | 17.45 | 1.86 |
| B | 22 | 16.91 | 2.31 |
| C | 25 | 17.56 | 2.00 |
| D | 9 | 17.56 | 2.46 |
| F | 17 | 16.76 | 1.79 |
| W | 7 | 17.00 | 1.91 |
| **Grand Total** | **219** | **19.31** | **3.44** |

Appendix (continued)

| Course Type | N of ACT Reading | Average | St. Dev. |
|---|---|---|---|
| **College English** | **220** | **20.42** | **5.27** |
| A | 59 | 21.86 | 5.12 |
| B | 68 | 20.38 | 4.81 |
| C | 32 | 17.97 | 4.12 |
| D | 14 | 18.86 | 6.88 |
| F | 42 | 20.50 | 5.72 |
| W | 5 | 23.40 | 5.55 |
| **Developmental English** | **42** | **15.36** | **2.96** |
| S | 29 | 15.41 | 3.02 |
| U | 13 | 15.23 | 2.95 |
| W | 0 | 0.00 | 0.00 |
| **Grand Total** | **262** | **19.61** | **5.30** |
| **Course Type** | **N of ALEKS** | **Average** | **St. Dev.** |
| **College Math** | **6** | **52.50** | **13.94** |
| A | 5 | 57.40 | 7.92 |
| B | 1 | 28.00 | 0.00 |
| C | 0 | 0.00 | 0.00 |
| D | 0 | 0.00 | 0.00 |
| F | 0 | 0.00 | 0.00 |
| W | 0 | 0.00 | 0.00 |
| **Developmental Math** | **77** | **24.83** | **7.60** |
| A | 13 | 29.46 | 6.83 |
| B | 17 | 25.41 | 7.42 |
| C | 20 | 25.95 | 7.04 |
| D | 7 | 25.71 | 8.67 |
| F | 16 | 19.44 | 5.78 |
| W | 4 | 21.75 | 8.92 |
| **Grand Total** | **83** | **26.83** | **10.83** |
| **Course Type** | **N of McCann Rdg** | **Average** | **St. Dev.** |
| **College English** | **139** | **100.57** | **14.17** |
| A | 30 | 107.80 | 15.97 |
| B | 35 | 100.20 | 14.69 |
| C | 27 | 96.48 | 10.53 |
| D | 11 | 95.18 | 8.74 |
| F | 25 | 96.72 | 10.79 |
| W | 10 | 101.80 | 12.36 |
| (blank) | 1 | 150.00 | 0.00 |
| **Developmental English** | **59** | **92.19** | **15.57** |
| S | 40 | 95.05 | 16.29 |
| U | 16 | 85.69 | 13.27 |
| W | 3 | 88.67 | 4.62 |
| **Grand Total** | **198** | **98.07** | **15.06** |
| **Course Type** | **N of McCann Wrtg** | **Average** | **St. Dev.** |
| **College English** | **138** | **4.86** | **0.67** |
| A | 30 | 4.73 | 0.69 |
| B | 35 | 4.97 | 0.62 |
| C | 27 | 4.81 | 0.74 |
| D | 11 | 5.00 | 0.77 |
| F | 24 | 4.79 | 0.59 |
| W | 10 | 4.90 | 0.74 |
| (blank) | 1 | 5.00 | 0.00 |
| **Developmental English** | **59** | **3.90** | **0.66** |
| S | 40 | 3.83 | 0.68 |
| U | 16 | 4.06 | 0.68 |
| W | 3 | 4.00 | 0.00 |
| **Grand Total** | **197** | **4.57** | **0.80** |