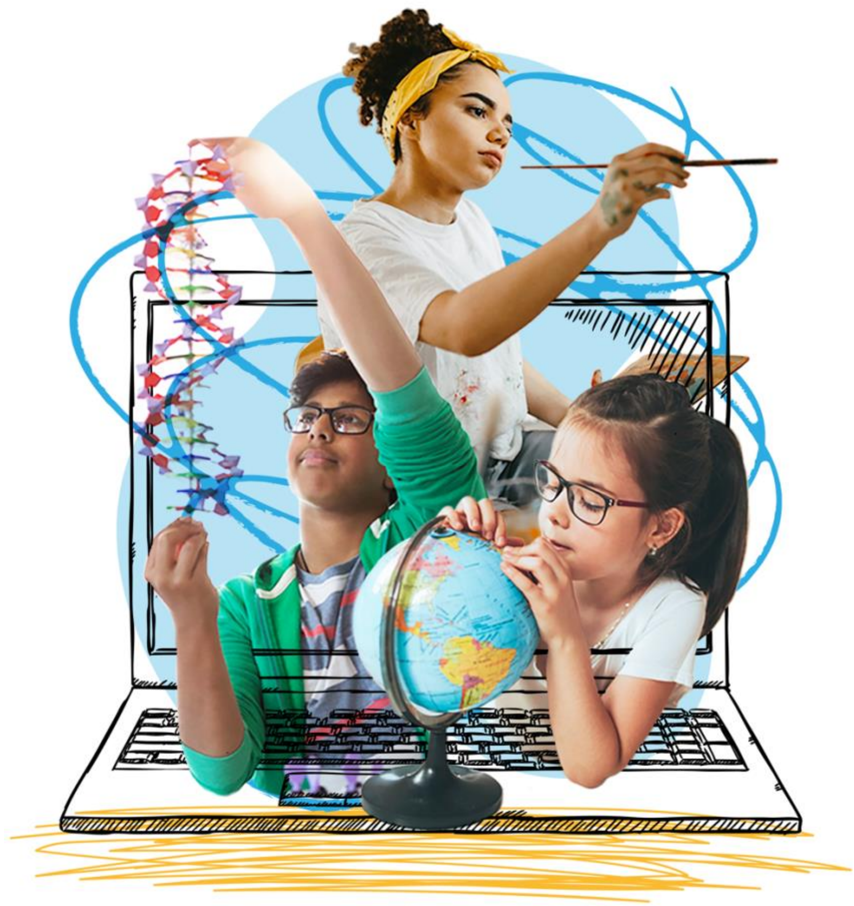

FLVS Chemistry Efficacy Study

Analysis, Assessment, and Accountability Team

The Florida Virtual School (FLVS) Analysis, Assessment, and Accountability team determined in collaboration with the FLVS Curriculum team that FLVS Flex Chemistry 1 and Chemistry 1 Honors courses are high enrollment courses that have undergone curriculum improvements in recent years. This document reports the pretest/posttest differences for student performance on the course module exams students completed in the 2018-19 and 2019-20 school years. The study focused on four research questions:

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Executive Summary

The Florida Virtual School (FLVS) Analysis, Assessment, and Accountability team determined in collaboration with the FLVS Curriculum team that FLVS Flex Chemistry 1 and Chemistry 1 Honors courses are high enrollment courses that have undergone curriculum improvements in recent years. This document reports the pretest/posttest differences for student performance on the course module exams students completed in the 2018-19 and 2019-20 school years. The study focused on four research questions:

1. *What do FLVS Flex Chemistry 1 module exam scores reveal about student course success?*
2. *How does student achievement in the FLVS Flex Chemistry 1 course differ among regular and honors courses?*
3. *How does student achievement differ across demographics (gender, ethnicity, and socio-economic status) in the FLVS Flex Chemistry 1 regular course?*
4. *How does student achievement differ across demographics (gender, ethnicity, and socio-economic status) in the FLVS Flex Chemistry 1 honors course?*

All comparisons of pretests and posttests across the eight modules in the Chemistry 1 and Chemistry 1 honors courses revealed statistically significant improvements in FLVS Flex students' module exam scores, with large or very large effect sizes. These findings demonstrated FLVS Flex Chemistry 1 students, both regular and honors, achieved course success as measured by module exams. All students also demonstrated similar gains across subgroups for all module exams.

Research Design

This study analyzed data from students in the FLVS Flex program. FLVS has two schools for Florida students and families to choose from: Full Time and Flex. FLVS Flex is a flexible option for students to take one or more courses online, which they can start anytime during the year. FLVS Flex students take FLVS courses while attending a traditional school or as a homeschool student. For this school, the traditional school or parent of the homeschooled student manages school transcripts.

Both FLVS Flex and FLVS Full Time courses offer the same curriculum and include synchronous and asynchronous instruction provided by Florida-certified teachers. The Chemistry 1 course includes eight modules, each with a pretest and posttest available and two segment exams.

This study considered students who enrolled in and completed the Chemistry 1 course in the FLVS Flex school during the 2018-19 and 2019-20 school years. Pretest and posttest data were analyzed separately for regular and honors students. Students who enroll in Chemistry 1 take the course as regular or honors students. When a student registers as an honors student, the course name may be referred to as “Chemistry 1 Honors.”

This study presents data stories from the regular and honors students separately. Honors students have additional test items due to the additional content standards that must be taught and assessed as compared to the regular students. The regular and honors exams are therefore not the same, and scores have been analyzed separately.

FLVS developed the Chemistry 1 course to ensure that the standards set by Florida are taught and assessed. Input from the National Science Teachers Association (NSTA) and the National Research Council (NRC) were incorporated by the state of Florida in their development of standards for Chemistry 1 and Chemistry 1 Honors. There are 79 standards for the core Chemistry 1 course, and an additional 14 standards taught and assessed in the honors course. All students complete the core Chemistry 1 course content while only students who register for honors complete the additional honors content embedded into the eight modules of the course and exam versions.

The course notes provided by the state of Florida that are published in conjunction with the state standards describe how the Chemistry 1 Honors course contrasts with the Chemistry 1 core course: students explore the same content and concepts in greater depth and rigor than they would in the regular course. Chemistry 1 Honors challenges students to think critically and apply often abstract, multi-faceted ideas built through understanding of complex texts and tasks. (See the CPALMs course description for additional information.)

Another aspect that is included in the Chemistry 1 course standards are the literacy standards for science. These standards require reading complex texts and engaging in extensive writing and research opportunities that emphasize students providing text-based evidence in their responses. (See a complete list of standards required for the regular course here and the honors course here.)

Research Questions

5. *What do FLVS Flex Chemistry 1 module exam scores reveal about student course success?*
6. *How does student achievement in the FLVS Flex Chemistry 1 course differ among regular and honors courses?*
7. *How does student achievement differ across demographics (gender, ethnicity, and socio-economic status) in the FLVS Flex Chemistry 1 regular course?*
8. *How does student achievement differ across demographics (gender, ethnicity, and socio-economic status) in the FLVS Flex Chemistry 1 honors course?*

Course Description

The high school chemistry course is a two-segment study of the foundations of chemistry, building on the concepts and scientific thinking laid in middle school science. Students use scientific inquiry and higher-order problem solving as they explore the composition, properties, and changes of matter and their applications through interactive simulations, engineering solutions, and virtual and hands-on experiences. Scientific inquiry, research, experimental procedures, data collection and analysis, and making inferences are an integral part of the learning experience. In addition, technology, engineering, and mathematics (STEM) concepts are integrated throughout the course. Through phenomenon-based learning, students will be able to demonstrate a vast understanding of the importance of chemistry in the world, enabling them to apply these principles to their everyday lives and our global society.

Segment 1 Module Exams

Matter

Atoms and Elements

Molecules and Compounds

Reactions

Segment 1 Cumulative Exam (not analyzed in this study due to lack of pretest data)

Segment 2 Module Exams

Stoichiometry

Phases of Matter

Energy in Reactions

Solutions

Segment 2 Cumulative Exam (not analyzed in this study due to lack of pretest data)

Description of the Research Sample

The research sample included FLVS Flex students who were enrolled in and completed the Chemistry 1 Version 18 course during the 2018-19 and 2019-20 school years. Tables 1 through 7 capture demographic characteristics of students in the population and those included in this analysis.

Table 1: Course Type of Students in the Research Sample (Regular and Honors)

	Course Type		
	Regular	Honors	Total
Number of Students	3074	2960	6034
Percent of Students	50.9	49.1	100
Number of Students in Matched Pairs Sample	2869	2757	5626
Percent of Students in Matched Pairs Sample	51.0	49.0	100

Approximately half of all students completing the Chemistry 1 course are honors students and about half are regular students.

Table 2: Grade Levels of Students in Research Sample (Regular Students)

Regular	Grade Level						
	6	7	8	9	10	11	12
Number of Students	2	3	14	106	975	1389	585
Percent of Students	0.1	0.1	0.5	3.4	31.7	45.2	19.0
Number of Students in Matched Pairs Sample	2	3	12	97	911	1309	535
Percent of Students in Matched Pairs Sample	0.1	0.1	0.4	3.4	31.8	45.6	18.6

Table 3: Grade Levels of Students in Research Sample (Honors Students)

Honors	Grade Level						
	6	7	8	9	10	11	12
Number of Students	1	6	44	355	1349	954	251
Percent of Students	0.0	0.2	1.5	12.0	45.6	32.2	8.5
Number of Students in Matched Pairs Sample	1	5	38	332	1245	900	236
Percent of Students in Matched Pairs Sample	0.0	0.2	1.4	12.0	45.2	32.6	8.6

About 75 percent of students that complete Chemistry 1 are 10th and 11th graders with almost all other students completing it while in high school. Only a few students take the course in middle school.

Table 4: Race/Ethnicities of Students in Research Sample (Regular Students)

Regular	Race/Ethnicity						
	American Indian or Alaska Native	Asian	Black or African American	Hispanic	Multi-Racial	Native Hawaiian or Other Pacific Islander	White
Number of Students	11	90	372	1001	121	5	1474
Percent of Students	0.4	2.9	12.1	32.6	3.9	0.2	48.0
Number of Students in Matched Pairs Sample	11	83	349	933	114	5	1374
Percent of Students in Matched Pairs Sample	0.4	2.9	12.2	32.5	4.0	0.2	47.9

Table 5: Race/Ethnicities of Students in Research Sample (Honors Students)

Honors	Race/Ethnicity						
	American Indian or Alaska Native	Asian	Black or African American	Hispanic	Multi-Racial	Native Hawaiian or Other Pacific Islander	White
Number of Students	12	214	251	878	130	2	1473
Percent of Students	0.4	7.2	8.5	29.7	4.4	0.1	49.8
Number of Students in Matched Pairs Sample	11	197	239	810	119	2	1379
Percent of Students in Matched Pairs Sample	0.4	7.1	8.7	29.4	4.3	0.1	50.0

The races/ethnicities of the students are self-reported. About half of students taking the course, whether honors or regular students were White. Nearly a third of students are Hispanic with some additional students taking the regular course as opposed to honors. Black students comprise just over 12 percent of regular students and nearly 9 percent of honors students. About 5 percent of students are Asian, and more than twice as many Asian students take the honors course as compared to the regular course. The remaining 5 percent of students reported themselves as American Indian or Alaskan Native, Native Hawaiian or Other Pacific Islander, or Multi-Racial.

For the purposes of this report, analyses focus on three categories: White, Minority (American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, and Hispanic), and Multi-Racial.

Table 6: Gender and Free Lunch Eligibility for Students in the Research Sample (Regular Students)

Regular	Gender		Eligible for Free/Reduced Lunch Program	
	Female	Male	Yes	No
Number of Students	1645	1429	1247	1827
Percent of Students	53.5	46.5	40.6	59.4

Number of Students in Matched Pairs Sample	1533	1336	1181	1688
Percent of Students in Matched Pairs Sample	53.4	46.6	41.2	58.8

Table 7: Gender and Free Lunch Eligibility for Students in the Research Sample (Honors Students)

Honors	Gender		Eligible for Free/Reduced Lunch Program	
	Female	Male	Yes	No
Number of Students	1754	1206	1012	1948
Percent of Students	59.3	40.7	34.2	65.8
Number of Students in Matched Pairs Sample	1627	1130	944	1813
Percent of Students in Matched Pairs Sample	59.0	41.0	34.2	65.8

More than half of students enrolled in the course at the time of the study were female and considerably more female students took the honors course as compared to the regular course. About 40 percent of students who completed the regular course received free and reduced lunches as compared to 34 percent of honors students.

Description of the Module Assessments

Within the FLVS Chemistry 1 course, there are eight pretests and eight posttests corresponding to each of the eight modules. Students complete four modules within each of two course segments. Thus, there are eight possible pretest/posttest comparisons across the eight program modules analyzing how students overall and in specified subgroups performed on the test items.

Each of the module pretest and posttest item banks are structured using groups of items. Each group of items is designed to measure the same benchmark(s) at the same cognitive complexity level. All students were administered a randomized subset of items from the corresponding item bank, stratified by item groups with a pre-specified number of items drawn from each group.

Each pretest or posttest module assessment includes from 14 to 22 groups of banked test items. The total number of test items in a pretest or posttest module item bank ranges from 42 to 66. To limit item exposure and promote academic integrity, each student receives one randomly selected item from each group. For any given group, all students are randomly assigned the same number of items from that group.

For the Chemistry 1 pretests, there are 122 pretest groups with multiple test items for each group. Overall, there are a total of 366 pretest items across 122 groups. This random sampling provides a broad assessment since all 366 items are included in the assessment bank, but each student takes only 14 to 16 items per test and a total of 122 pretest items throughout the course.

Each posttest includes either 18 (regular) or 22 (honors) groups of banked test items for a total of 144 (regular) or 176 (honors) test items. Again, to limit exposure and promote academic integrity, each student randomly receives only a subset of test items from the bank. Each group of items is designed to measure the same benchmark(s) at the same cognitive complexity level. This random sampling provides a broad assessment since all 432 (regular) or 528 (honors) items are included in the assessment bank, but each student takes only 18 (regular) or 22 (honors) items per test and a total of 432 (regular) or 528 (honors) posttest items throughout the course.

According to the FLVS course development guidelines, a test blueprint is created for each pre-test and module exam. Each test item is written to measure a particular benchmark at an appropriately specified cognitive complexity level based on an adaptation of Webb's Depth of Knowledge. Tests and test items are reviewed by subject matter experts and editorial staff, and tests are assembled per blueprint requirements.

Table 8: Items for Pretest Module Assessments

	Regular and Honors	
Pretest Modules	Total # of Banked Items	# of Items per Student
Module 1 Matter	48	16
Module 2 Atoms and Elements	48	16
Module 3 Molecules and Compounds	45	15
Module 4 Reactions	45	15
Module 5 Stoichiometry	42	14
Module 6 Phases of Matter	48	16
Module 7 Energy in Reactions	45	15
Module 8 Solutions	45	15

Table 9: Items for Posttest Module Regular Assessments

Posttest Modules	Total # of Banked Items	# of Items per Student
Module 1 Matter	54	18
Module 2 Atoms and Elements	54	18
Module 3 Molecules and Compounds	54	18
Module 4 Reactions	54	18
Module 5 Stoichiometry	54	18
Module 6 Phases of Matter	54	18
Module 7 Energy in Reactions	54	18
Module 8 Solutions	54	18

Table 10: Items for Posttest Module Honors Assessments

Posttest Modules	Total # of Banked Items	# of Items per Student
Module 1 Matter	66	22
Module 2 Atoms and Elements	66	22
Module 3 Molecules and Compounds	66	22
Module 4 Reactions	66	22
Module 5 Stoichiometry	66	22
Module 6 Phases of Matter	66	22
Module 7 Energy in Reactions	66	22
Module 8 Solutions	66	22

The pretests and posttests assess the standards and benchmarks covered in each Chemistry 1 module. The assessments focus on the skills, strategies, and knowledge necessary for effective understanding of chemistry.

Data Analyses and Results

Data analyses focused on students' percent correct scores due to differing numbers of test items on pretests and posttests. Only students receiving scores for both a pretest and a posttest in each module were included in the analysis.

Separate analyses were conducted for each of the modules 1-8 for Flex regular students and for Flex honors students. Modules 1-4 comprise the first segment (equivalent to a first semester of work) and modules 4-8 the second segment (equivalent to a second semester of work).

Analysis Description

The following analyses were conducted to determine answers to the research questions that guided this study:

1. Pretest/posttest comparisons, using Paired Comparison t-tests, were used to analyze student growth within each module. The Paired Comparison t-tests determined if there were any statistically significant increase in differences among student scores for defined subgroups. The p-value that determined statistical significance was $p \leq 0.05$.
2. Students within the regular and honors courses were divided into sub-groups based on the following criteria:
    a. gender (male or female)
    b. socio-economic status (determined by eligibility for free/reduced lunch programs or non-eligibility)
    c. race/ethnicity (White, minority, or multi-racial). For the purposes of this report and due to the number of students in each subgroup, analyses focused on three categories: White, Minority (American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, and Hispanic), and Multi-Racial.
3. An effect-size analysis was computed for each of the paired t-tests. Cohen's d statistic was used to determine the effect size. This statistic provided an indication of the strength of the treatment effect regardless of the statistical significance. A significant p-value tells us that student growth scores increased between pretest and posttest, whereas an effect size tells us whether that difference was large enough to matter. Cohen's d statistic is interpreted as follows:
    a. 0.2 = small effect
    b. 0.5 = medium effect
    c. 0.8 = large effect

Results for Each Module

The coming sections explain analysis results from each segment in the FLVS Flex Chemistry 1 course with sufficient data from school years 2018-19 and 2019-20, with separate analyses for regular and honors students.

Segment 1 Module 1: Matter

The following excerpt helps introduce the course module to students: Consider the anchoring phenomenon for this module: The chemistry of our atmosphere and oceans is changing. To understand the intricate system of events causing the changes to our atmosphere and oceans, you must first gain the background knowledge you need to be a skilled scientist (or chemist). This means knowing the properties and changes seen in matter, and all the ways to measure them. It's also useful to learn the different phases of matter and the various ways matter can mix together. Lastly, knowing laboratory techniques and practicing experimentation will assist you during your chemistry investigations.

The list of skills students developed while completing this lesson include:

- Explaining the characteristics of science and its limitations
- Describing the steps of the scientific method
- Describing the traits of a reliable investigation

In this module, the increases from pretest to posttest for all students, both regular and honors, in every subgroup were statistically significant (≤.0001). The effect sizes were all greater than 1.3, which is very large.

Across all subgroups and overall, the honors students scored higher than the regular students on both pretests and posttests. Regular students had a mean score of 53% on pretests and 81% on posttests while honors students had a mean score of 61% on pretests and 87% on posttests. There was some slight variation in mean scores across the various subgroups studied. Overall, regular students made a 28% gain from pretest to posttest in Module 1, with subgroups making gains ranging from 24% to 28%. Honors students made a 26% gain overall; students with subgroup gains ranged from 24% to 27%.

The following figures indicate the percent correct scores across the research sample in this module for regular and honors students, respectively. See the Appendix for complete results.

Figure 1: Chemistry 1 Segment 1, Module 1

Pretest to Posttest Percent Correct Scores for All Regular Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)

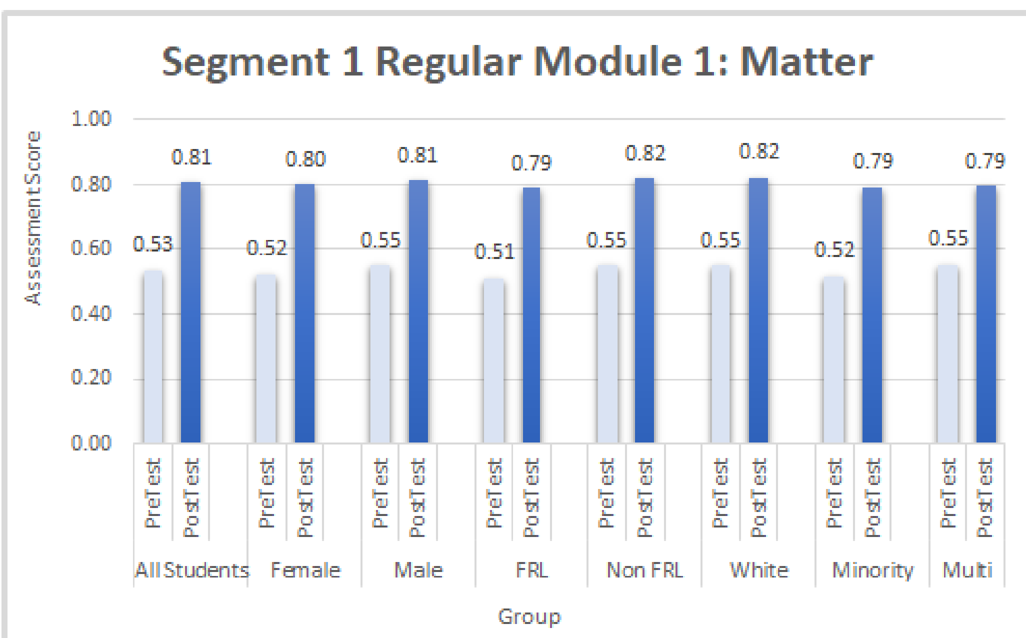
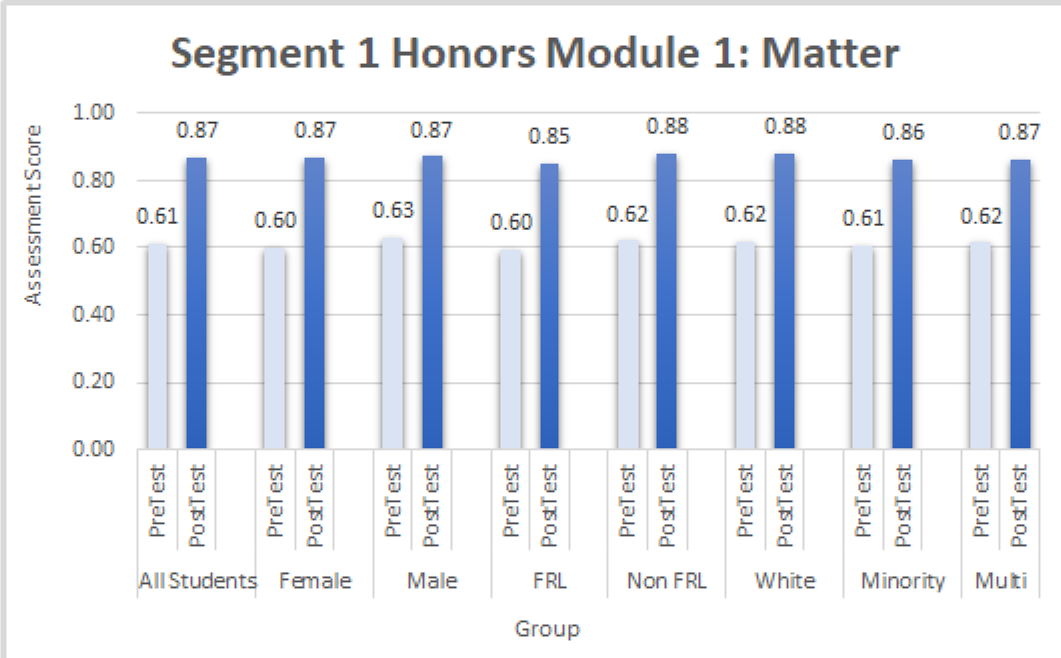


Figure 2: Chemistry 1 Segment 1, Module 1

Pretest to Posttest Percent Correct Scores for All Honors Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)



Module 2: Atoms and Elements

The following excerpt helps introduce the course module to students: *Consider the anchoring phenomenon for this module:* Particles of matter have unique properties and can create large amounts of energy. *It's hard to believe that something as small as an atom, and the tiny particles within it, could be a source of large amounts of energy, but, it's true. Atomic energy, electricity, star explosions—they all come from the motion or changes of subatomic particles. Let's zoom into the structure of the atom and learn more about the arrangement and behavior of these tiny particles. Exactly how can we derive energy from their interactions?*

The list of skills developed while completing this lesson include:

- Describing the ways matter is measured
- Identifying the correct unit for each form of measurement
- Converting between and within English and metric measurements

In this module, the increases from pretest to posttest for all students, both regular and honors, in every subgroup were statistically significant (≤.0001). The effect sizes were all greater than 1.5, which is very large.

Across all subgroups and overall, the honors students scored higher than the regular students on both pretests and posttests. Regular students had a mean score of 42% on pretests and 77% on posttests while honors students had a mean score of 45% on pretests and 83% on posttests. There was some slight variation in mean scores across the various subgroups studied. Overall, regular students made a 35% gain from pretest to posttest in Module 2, with subgroups making gains ranging from 35% to 36%. Honors students made a 38% gain over all students with subgroup gains ranging from 37% to 40%.

The following figures indicate the percent correct scores across the research sample in this module for regular and honors students, respectively. See Appendix for complete results.

Figure 3: Chemistry 1 Segment 1, Module 2

Pretest to Posttest Percent Correct Scores for All Regular Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)

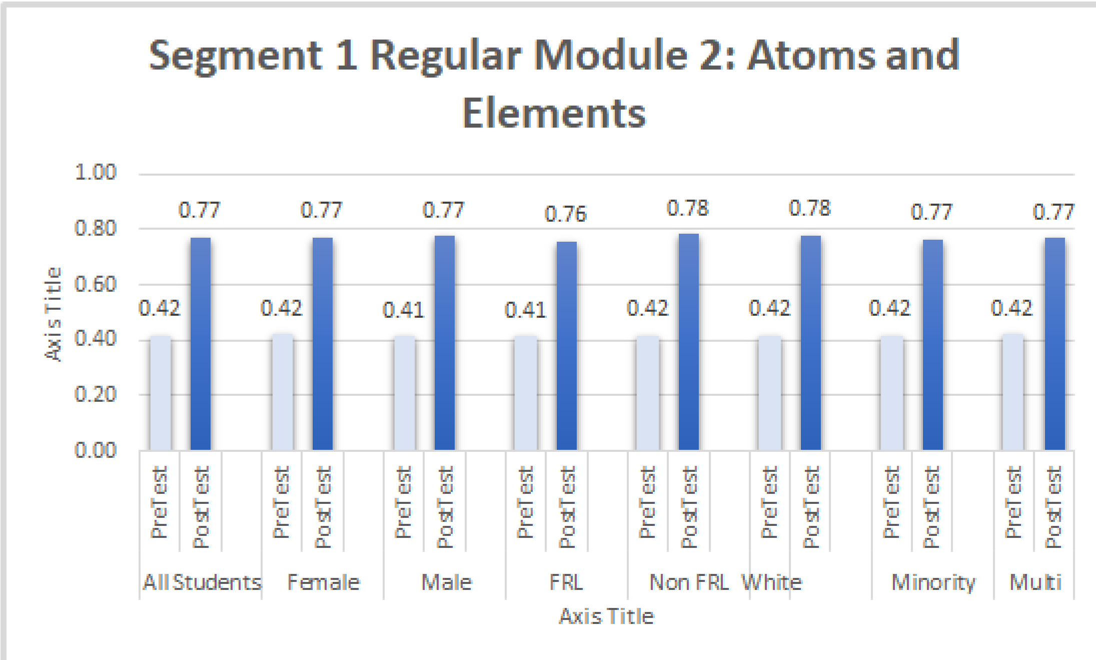
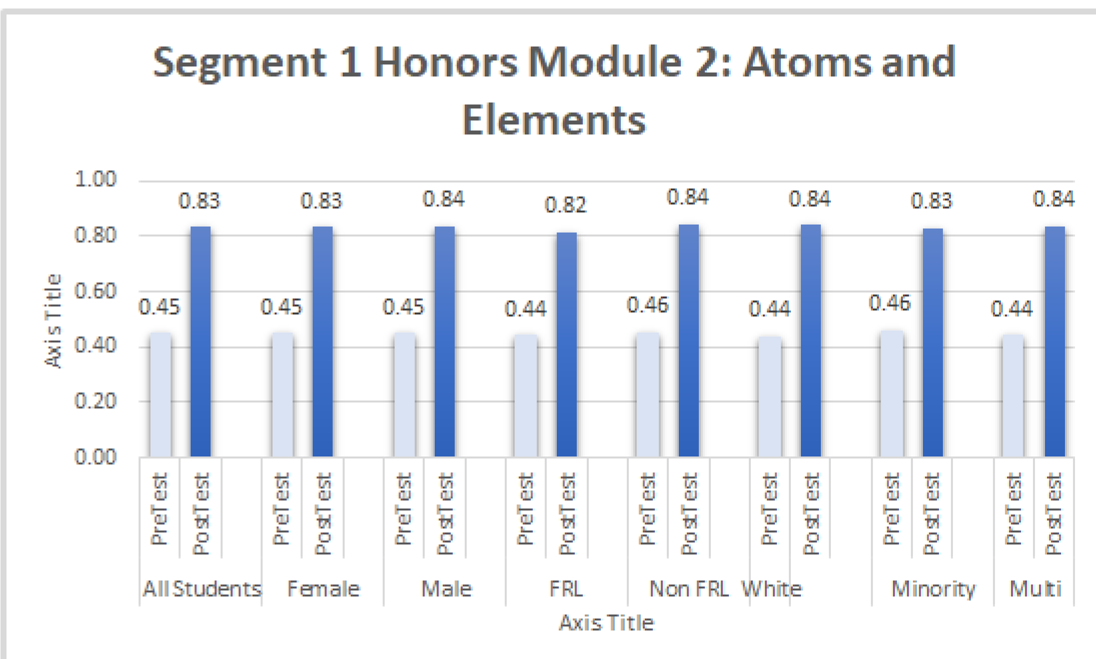


Figure 4: Chemistry 1 Segment 1, Module 2

Pretest to Posttest Percent Correct Scores for All Honors Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)



Module 3: Molecules and Compounds

The following excerpt helps introduce the course module to students: *Consider the anchoring phenomenon for this module*: Chemical bonds are broken and created during chemical reactions. *There are different types of bonding and different reasons bonds form or don't form between elements. Let's research how bonds are formed, the different bond types, the molecular structures of compounds, and the forces that help break and create bonds during chemical reactions.*

The list of skills developed while completing this lesson include:

- Differentiating between different forms of energy
- Recognizing that energy cannot be created or destroyed
- Describing various ways in which energy is transferred from one system to another
- Explaining how the motion of particles (atoms and molecules) changes with temperature

In this module, the increases from pretest to posttest for all students, both regular and honors, in every subgroup were all statistically significant (≤.0001). The effect sizes were all greater than 1.5, which is very large.

Across all subgroups and overall, the honors students scored higher than the regular students on both pretests and posttests. Regular students had a mean score of 37% on pretests and 77% on posttests while honors students had a mean score of 39% on pretests and 84% on posttests. There was some slight variation in mean scores across the various subgroups studied. Overall, regular students made a 40% gain from pretest to posttest in Module 3, with subgroups making gains ranging from 39% to 42%. Honors students made a 45% gain over all students with subgroup gains ranging from 43% to 49%.

The figures below indicate the percent correct scores across the research sample in this module for regular and honors students, respectively. See Appendix for complete results.

Figure 5: Chemistry 1 Segment 1, Module 3

Pretest to Posttest Percent Correct Scores for All Regular Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)

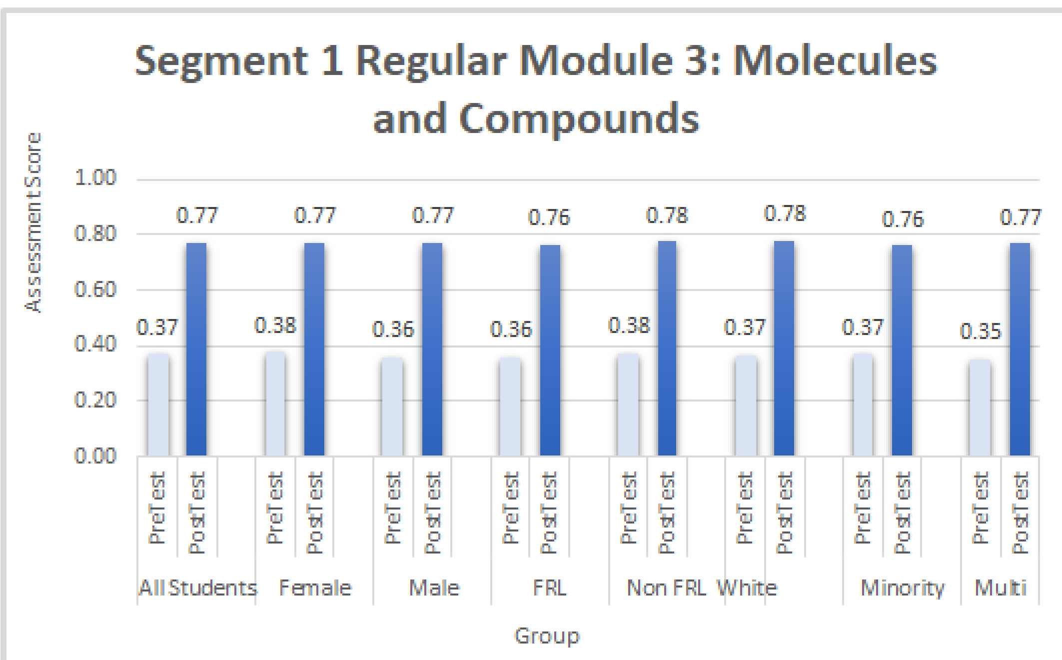
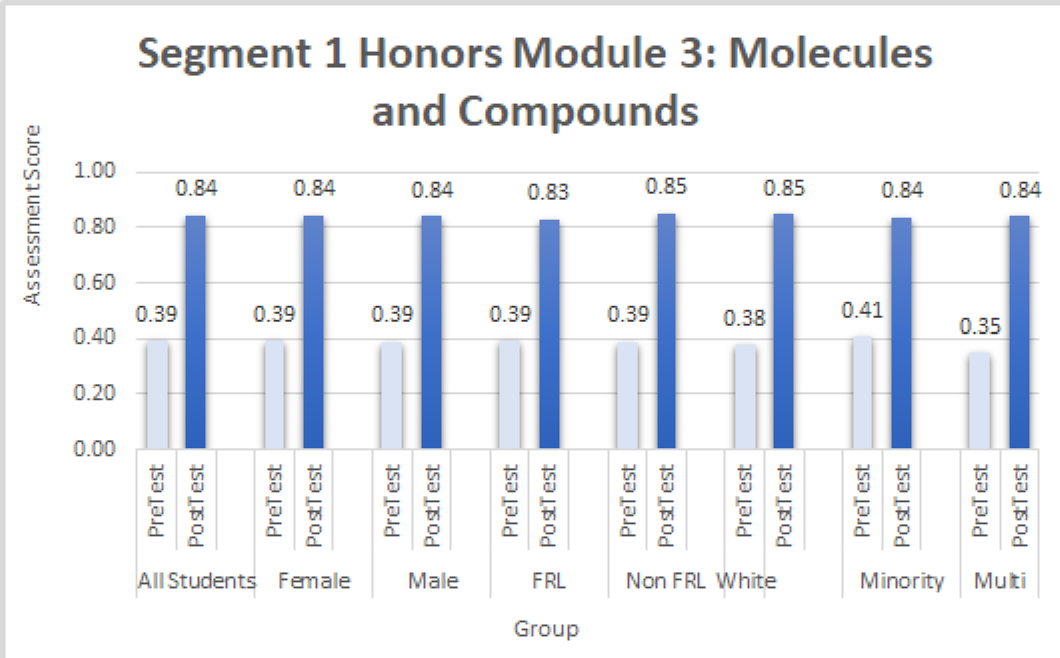


Figure 6: Chemistry 1 Segment 1, Module 3

Pretest to Posttest Percent Correct Scores for All Honors Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)



Module 4: Reactions

The following excerpt helps introduce the course module to students: Consider the anchoring phenomenon for this module: Chemical reactions occur in predictable patterns. Different types of chemical reactions occur between elements and compounds. Let's review the various types of chemical reactions and learn ways to recognize each reaction during experimentation.

The list of skills developed while completing this lesson include:

- Differentiating between the four states of matter
- Describing physical and chemical properties
- Differentiating between physical and chemical properties

In this module, the increases from pretest to posttest for all students, both regular and honors, in every subgroup were statistically significant (≤.0001). The effect sizes were all greater than 1.5, which is very large.

Across all subgroups and overall, the honors students scored higher than the regular students on both pretests and posttests. Regular students had a mean score of 41% on pretests and 80% on posttests while honors students had a mean score of 45% on pretests and 87% on posttests. There was some slight variation in mean scores across the various subgroups studied. Overall, regular students made a 39% gain from pretest to posttest in Module 4, with subgroups making gains ranging from 39% to 46%. Honors students made a 42% gain over all students with subgroup gains ranging from 39% to 43%.

The figures below indicate the percent correct scores across the research sample in this module for regular and honors students, respectively. See Appendix for complete results.

Figure 7: Chemistry 1 Segment 1, Module 4

Pretest to Posttest Percent Correct Scores for All Regular Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)

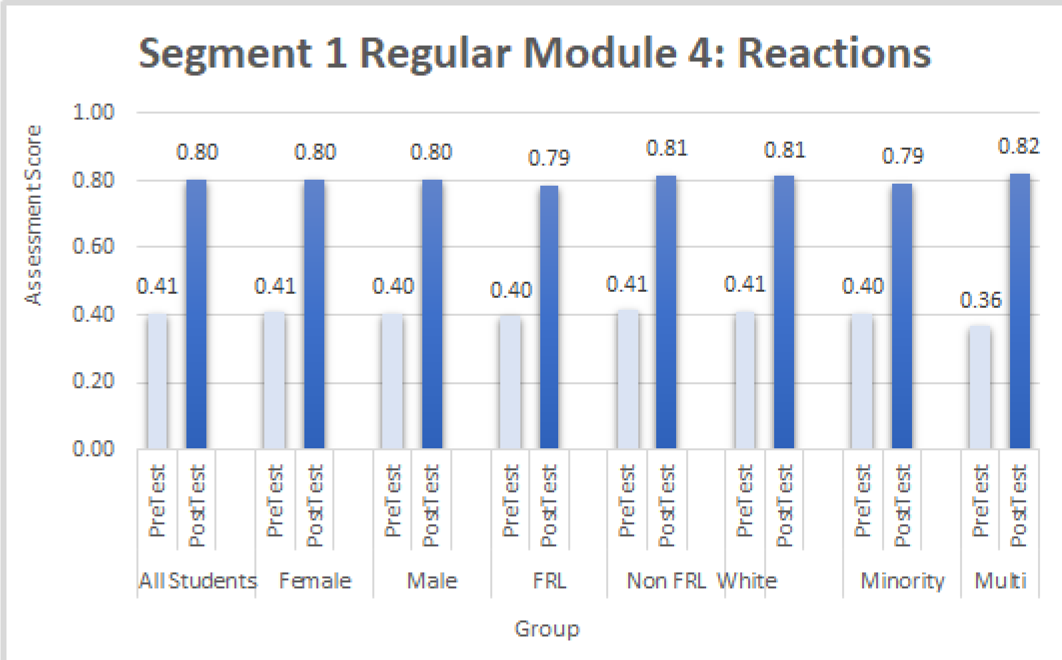
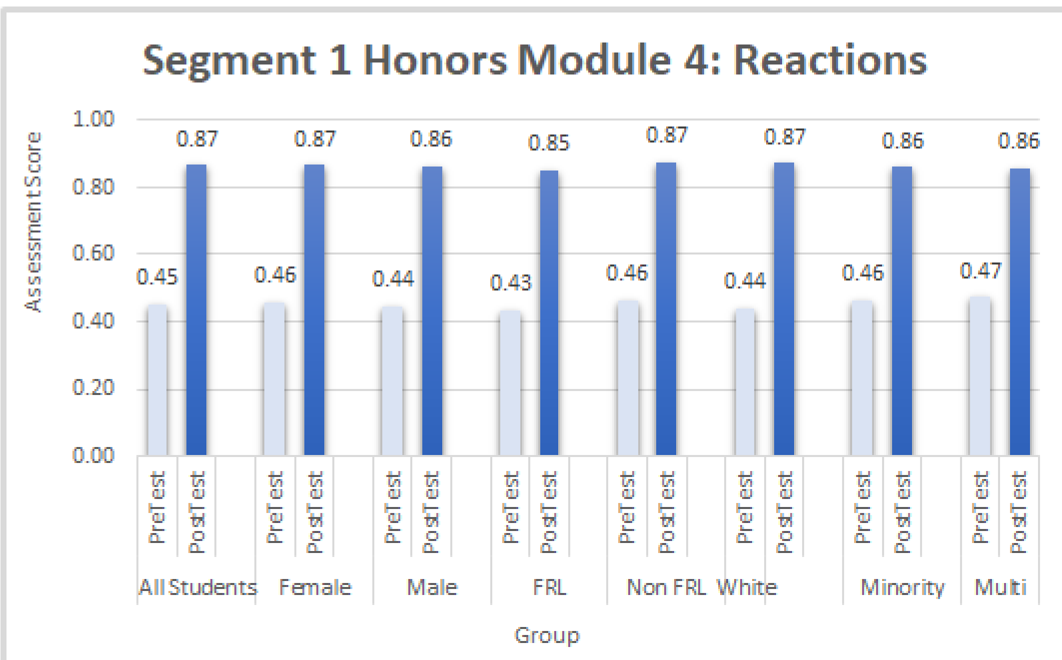


Figure 8: Chemistry 1 Segment 1, Module 4

Pretest to Posttest Percent Correct Scores for All Honors Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)



Segment 2 Module 5: Stoichiometry

The following excerpt helps introduce the course module to students: *Consider the anchoring phenomenon for this module:* Chemical compounds and reactions occur in definite proportions. *This module is all about using proper proportions in chemistry and how to calculate these ratios for chemical reactions. The use of definite proportions allows scientists to determine the correct amount of substances to use in chemical reactions. This is a chemistry process known as stoichiometry, where chemists use dimensional analysis to calculate relationships between the amounts of reactants and products in chemical reactions.*

The list of skills developed while completing this lesson include:

- Differentiate between physical and chemical changes
- Explain the effects of physical and chemical changes on molecular interactions
- Explain how temperature affects particle motion during phase change

In this module, the increases from pretest to posttest for all students, both regular and honors, in every subgroup were statistically significant (≤.0001). The effect sizes were all greater than 1.5, which is very large.

Across all subgroups and overall, the honors students scored higher than the regular students on both pretests and posttests. Regular students had a mean score of 38% on pretests and 77% on posttests while honors students had a mean score of 41% on pretests and 83% on posttests. There was some slight variation in mean scores across the various subgroups studied. Overall, regular students made a 39% gain from pretest to posttest in Module 5, with subgroups making gains ranging from 37% to 41%. Honors students made a 42% gain over all students with subgroup gains ranging from 40% to 44%.

The following figures indicate the percent correct scores across the research sample in this module for regular and honors students, respectively. See Appendix for complete results.

Figure 9: Chemistry 1 Segment 2, Module 5

Pretest to Posttest Percent Correct Scores for All Regular Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)

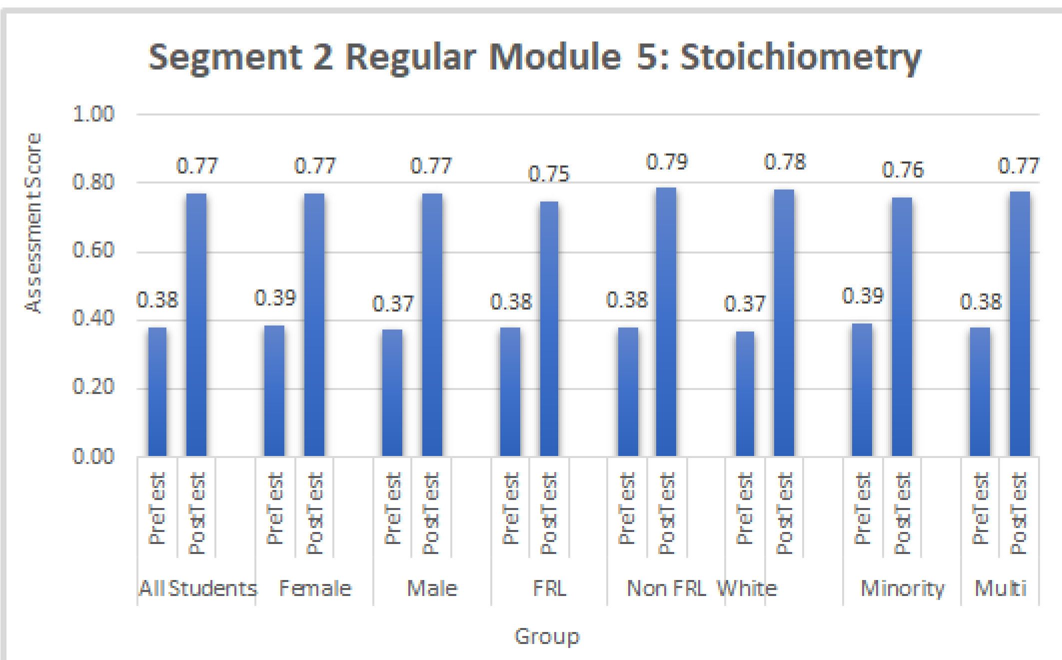
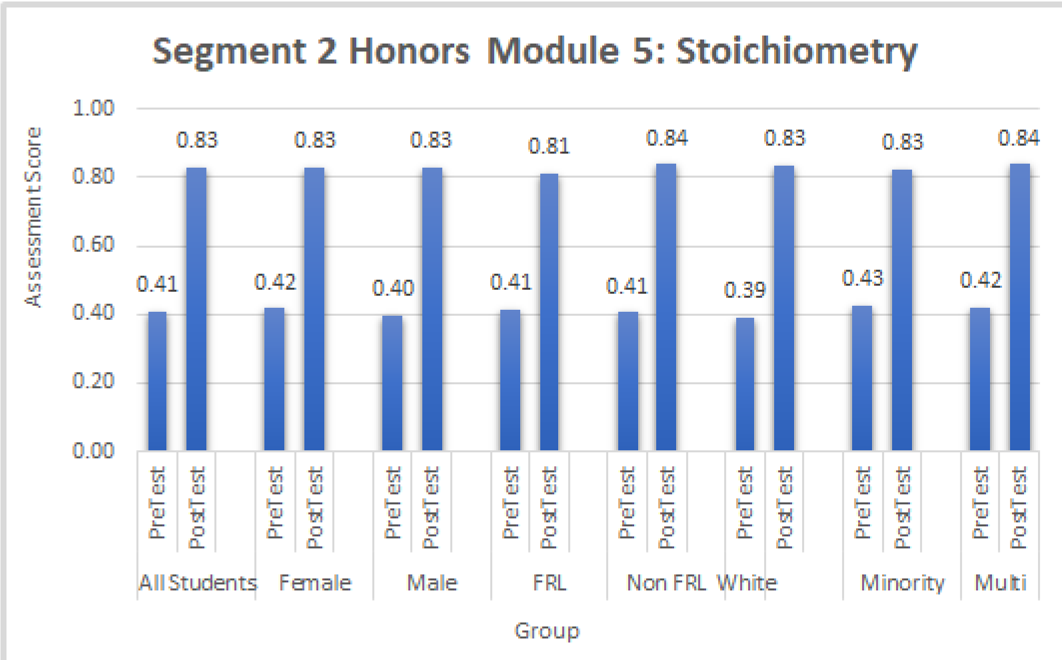


Figure 10: Chemistry 1 Segment 2, Module 5

Pretest to Posttest Percent Correct Scores for All Honors Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)



Module 6: Phases of Matter

The following excerpt helps introduce the course module to students: *Consider the anchoring phenomenon for this module:* Gases behave in predictable ways in relation to their volume, pressure, and temperature. *Gas molecules behave according to specific theories and laws that predict their actions under various conditions. Exploring kinetic molecular theory and particle behavior will increase our understanding of the different phases of matter, including gases, and phase changes.*

- The list of skills developed while completing this lesson include:
- Classify matter as mixtures or pure substances based on their properties
- Differentiate between compounds and mixtures
- Describe how mixtures can be separated based on their properties

In this module, the increases from pretest to posttest for all students, both regular and honors, in every subgroup were statistically significant (≤.0001). The effect sizes were all greater than 1.5, which is very large.

Across all subgroups and overall, the honors students scored higher than the regular students on both pretests and posttests. Regular students had a mean score of 41% on pretests and 78% on posttests while honors students had a mean score of 46% on pretests and 85% on posttests. There was some slight variation in mean scores across the various subgroups studied. Overall, regular students made a 37% gain from pretest to posttest in Module 6, with subgroups making gains ranging from 34% to 37%. Honors students made a 39% gain over all students with subgroup gains ranging from 36% to 40%.

The following figures indicate the percent correct scores across the research sample in this module for regular and honors students, respectively. See Appendix for complete results.

Figure 11: Chemistry 1 Segment 2, Module 6

Pretest to Posttest Percent Correct Scores for All Regular Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)

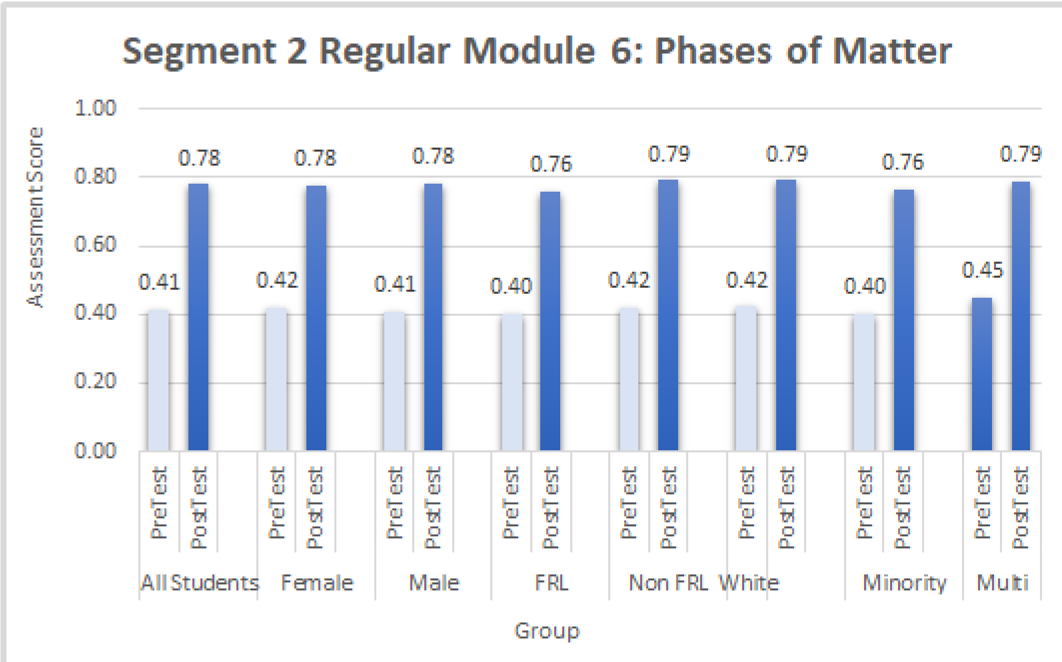
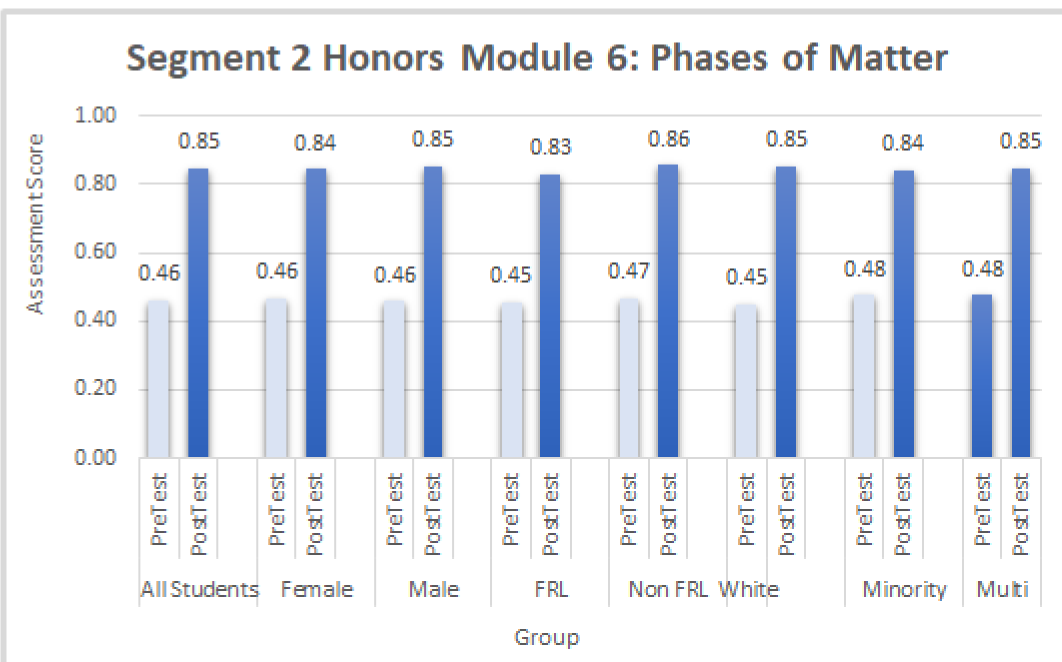


Figure 12: Chemistry I Segment 2, Module 6

Pretest to Posttest Percent Correct Scores for All Honors Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)



Module 7: Energy in Reactions

The following excerpt helps introduce the course module to students: *Consider the anchoring phenomenon for this module:* There is a transfer of energy associated with the formation of new chemical compounds. *The movement of energy influences the behavior of reactants and products, as does the amount of heat energy involved in a reaction. Let's learn how energy transfer affects chemical reactions.*

The list of skills developed while completing this lesson include:

- Identify lab equipment and parts of an experiment
- Report measurements and calculations based on uncertainty
- Plan and conduct an investigation to answer a question regarding physical properties

In this module, the increases from pretest to posttest for all students, both regular and honors, in every subgroup were statistically significant (≤.0001). The effect sizes were all greater than 1.5, which is very large.

Across all subgroups and overall, the honors students scored higher than the regular students on both pretests and posttests. Regular students had a mean score of 34% on pretests and 73% on posttests while honors students had a mean score of 37% on pretests and 81% on posttests. There was some slight variation in mean scores across the various subgroups studied. Overall, regular students made a 39% gain from pretest to posttest in Module 7, with subgroups making gains ranging from 37% to 40%. Honors students made a 44% gain over all students with subgroup gains ranging from 44% to 45%.

The figures below indicate the percent correct scores across the research sample in this module for regular and honors students, respectively. See Appendix for complete results.

Figure 13: Chemistry 1 Segment 2, Module 7

Pretest to Posttest Percent Correct Scores for All Regular Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)

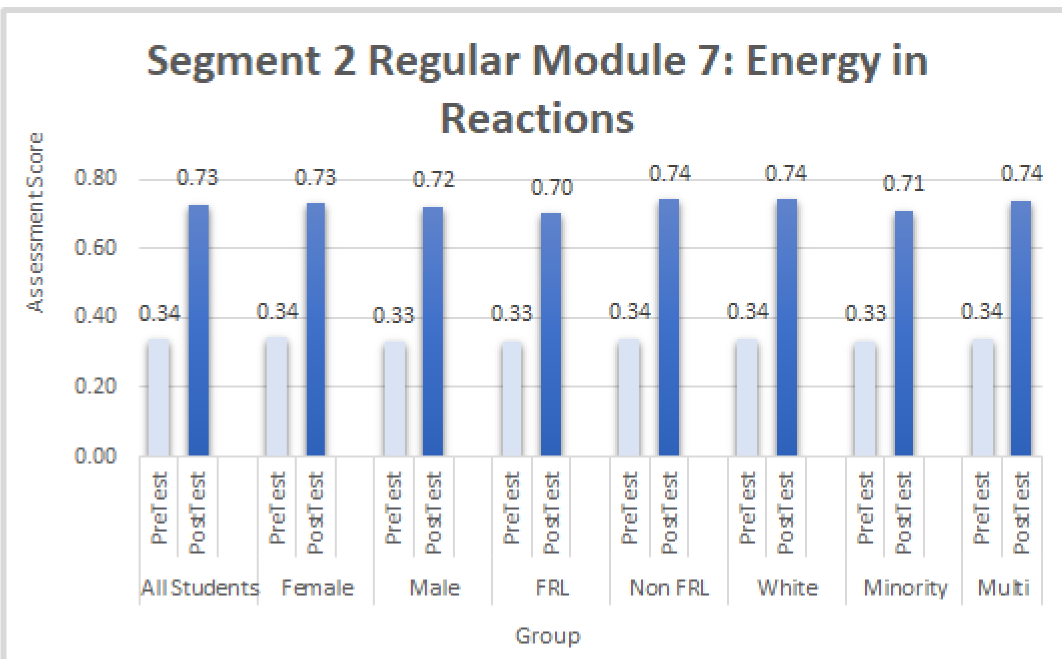
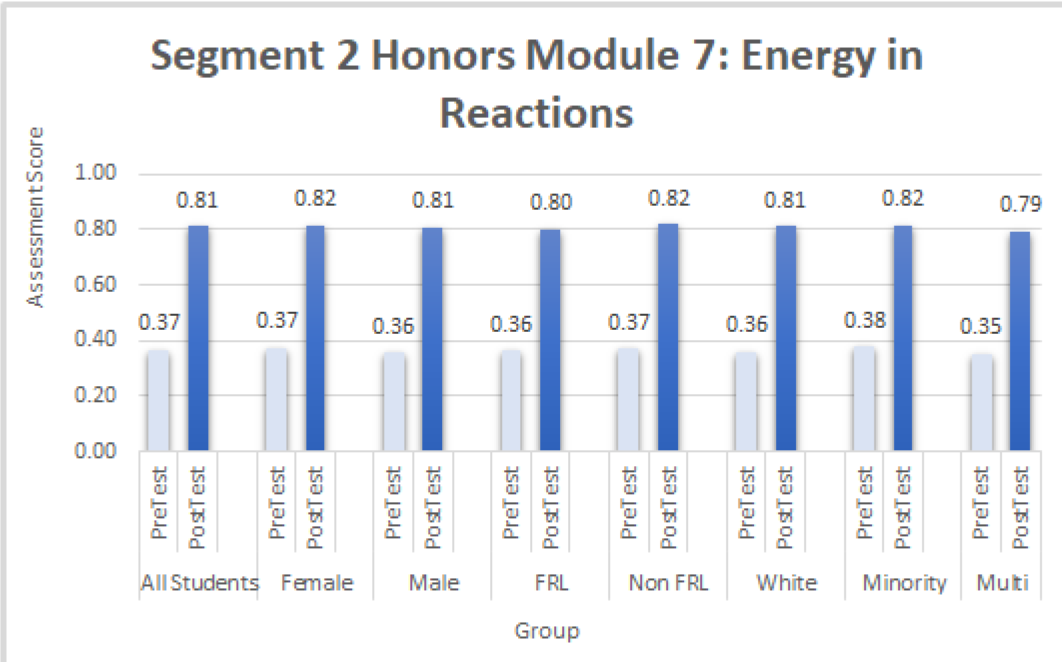


Figure 14: Chemistry 1 Segment 2, Module 7

Pretest to Posttest Percent Correct Scores for All Honors Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)



Module 8: Solutions

The following excerpt helps introduce the course module to students: ***Consider the anchoring phenomenon for this module:*** **Water is a critical substance in many physical and chemical changes*****. In this module, you will examine how substances respond in solution and the benefits of conducting chemical reactions within solutions. You will also learn about the pH scale and the unique properties of acids and bases. Lastly, you will discover additional factors that can further influence the success of chemical reactions within solutions.***

The list of skills developed while completing this lesson include:

- Identify examples of pseudoscience
- Determine if a phenomenon can be observed, measured, and tested through scientific experimentation
- Explain that scientific explanations are accepted when they are consistent with evidence
- Distinguish between scientific hypotheses and scientific theories

In this module, the increases from pretest to posttest for all students, both regular and honors, in every subgroup were statistically significant (≤.0001). The effect sizes were all greater than 1.5, which is very large.

Across all subgroups and overall, the honors students scored higher than the regular students on both pretests and posttests. Regular students had a mean score of 38% on pretests and 84% on posttests while honors students had a mean score of 40% on pretests and 89% on posttests. There was some slight variation in mean scores across the various subgroups studied. Overall, regular students made a 46% gain from pretest to posttest in Module 8, with subgroups making gains ranging from 46% to 48%. Honors students made a 49% gain over all students with subgroup gains ranging from 46% to 51%.

The figures below indicate the percent correct scores across the research sample in this module for regular and honors students, respectively. See Appendix for complete results.

Figure 15: Chemistry 1 Segment 2, Module 8

Pretest to Posttest Percent Correct Scores for All Regular Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)

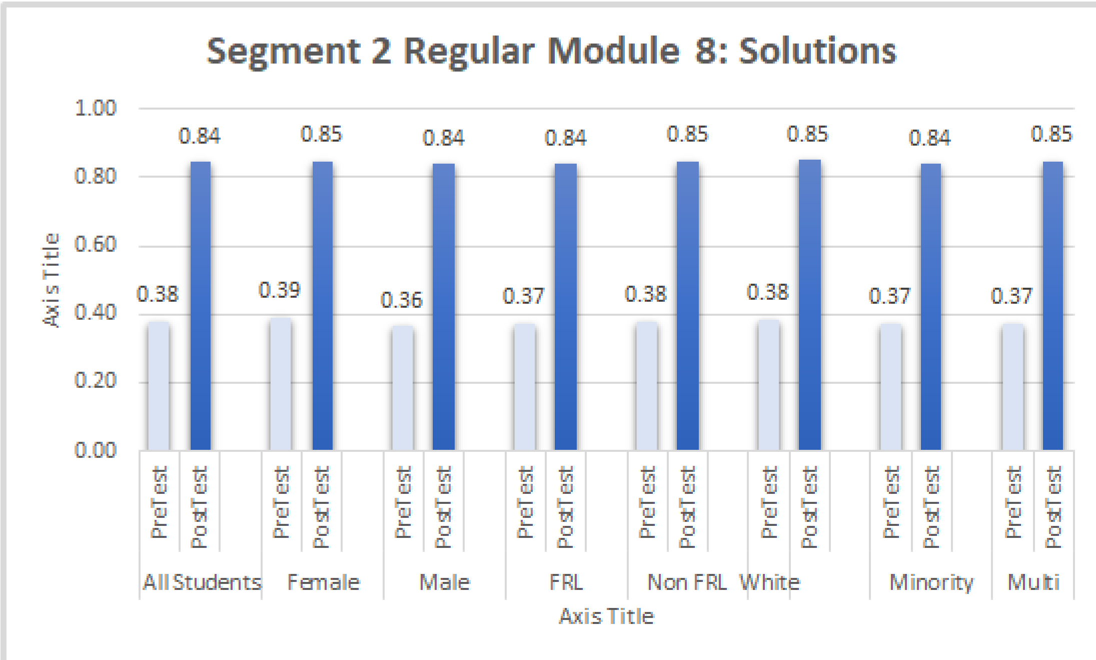
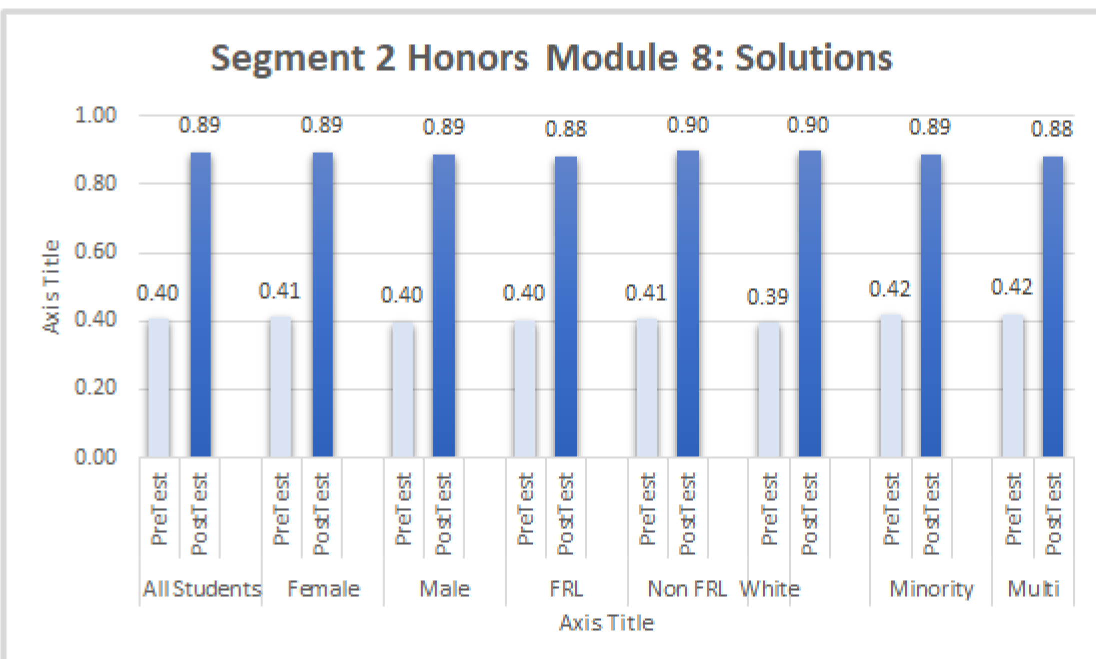


Figure 16: Chemistry 1 Segment 2, Module 8

Pretest to Posttest Percent Correct Scores for All Honors Students and by Subgroups (Female/Male, Free and Reduced Lunch/Non-Free and Reduced Lunch, White/Minority/Multi-Racial)



Conclusions

This section reviews the data analyzed to respond to each of the research questions that guided the study of the FLVS Chemistry 1 course. As you may recall, a significant p-value tells us that student scores increased between pretest and posttest, whereas an effect size tells us whether that difference was large enough to matter.

Question 1: *What do FLVS Flex Chemistry 1 module exam scores reveal about student course success?*

For all t-test comparisons across the eight module exam scores, the increases from each pretest to posttest in both Chemistry 1 and Chemistry 1 Honors were statistically significant, with very large effect sizes. Students' significant improvement from pretests to posttests across these exam scores indicate overall students achieved success in all modules both the 2018-19 and 2019-20 school years.

Question 2: How does student achievement in the FLVS Flex Chemistry 1 course differ among regular and honors courses?

Across all subgroups and overall, Chemistry 1 Honors students scored higher on both pretests and posttests. The increases between all pretests and posttests across subgroups were statistically significant with large effect sizes as well.

Question 3: How does student achievement differ across demographics (gender, ethnicity, and socio-economic status) in the FLVS Flex Chemistry 1 regular course?

Student results were similar across demographics in the eight modules for the regular Chemistry 1 course.

Question 4: How does student achievement differ across demographics (gender, ethnicity, and socio-economic status) in the FLVS Flex Chemistry 1 Honors course?

Likewise, student results were similar across demographics in the eight modules for Chemistry 1 Honors.

In general, the results from the comparisons across each module show Chemistry 1 Honors students consistently scored higher on their pretests and posttests, but in all other areas, student groups scored similarly. Student scores significantly improved from pretests to posttests, demonstrating students' improved understandings of concepts in Chemistry.

Appendix: Complete Results for Each Module and Student Type

Table 1: Chemistry 1 Module 1: Matter
Comparison of Pretest and Posttest Percent Correct Scores
Regular Students

Group	Test	Number	Mean	Standard Deviation	Mean Difference	t-Test	Significance	Effect Size
All Students	Pretest	1489	53%	0.16	27%	58.74	<.0001	1.52
	Posttest	1489	81%	0.11				
Female	Pretest	820	52%	0.15	28%	48.03	<.0001	1.68
	Posttest	820	80%	0.11				
Male	Pretest	669	55%	0.17	26%	35.35	<.0001	1.37
	Posttest	669	81%	0.11				
FRL	Pretest	639	51%	0.16	28%	38.73	<.0001	1.53
	Posttest	639	79%	0.12				
Non FRL	Pretest	850	55%	0.17	27%	44.15	<.0001	1.51
	Posttest	850	82%	0.11				
White	Pretest	711	55%	0.16	27%	40.89	<.0001	1.53
	Posttest	711	82%	0.11				
Minority	Pretest	723	52%	0.16	27%	40.86	<.0001	1.52
	Posttest	723	79%	0.12				
Multi-Racial	Pretest	55	55%	0.16	24%	10.40	<.0001	1.40
	Posttest	55	79%	0.11				

Table 2: Chemistry 1 Module 1: Matter Comparison of Pretest and Posttest Percent Correct Scores Honors Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1529	61%	0.17	26%	60.61	<.0001	1.55
	Posttest	1529	87%	0.09				
Female	Pretest	903	60%	0.16	27%	49.59	<.0001	1.65
	Posttest	903	87%	0.09				
Male	Pretest	626	63%	0.17	24%	35.61	<.0001	1.42
	Posttest	626	87%	0.09				
FRL	Pretest	542	60%	0.17	26%	36.75	<.0001	1.58
	Posttest	542	85%	0.09				
Non FRL	Pretest	987	62%	0.17	26%	48.22	<.0001	1.53
	Posttest	987	88%	0.09				
White	Pretest	745	62%	0.17	26%	42.31	<.0001	1.55
	Posttest	745	88%	0.09				
Minority	Pretest	717	61%	0.17	26%	41.18	<.0001	1.54
	Posttest	717	86%	0.10				
Multi-Racial	Pretest	67	62%	0.16	25%	13.86	<.0001	1.69
	Posttest	67	87%	0.09				

Table 3: Chemistry 1 Module 2: Atoms and Elements Comparison of Pretest and Posttest Percent Correct Scores Regular Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1491	42%	0.18	36%	63.57	<.0001	1.65
	Posttest	1491	77%	0.13				
Female	Pretest	813	42%	0.18	35%	47.59	<.0001	1.67
	Posttest	813	77%	0.13				
Male	Pretest	678	41%	0.18	36%	42.24	<.0001	1.62
	Posttest	678	77%	0.13				
FRL	Pretest	635	41%	0.18	34%	40.14	<.0001	1.59
	Posttest	635	76%	0.13				
Non FRL	Pretest	856	42%	0.18	36%	49.39	<.0001	1.69
	Posttest	856	78%	0.13				
White	Pretest	716	42%	0.18	36%	44.04	<.0001	1.65
	Posttest	716	78%	0.14				
Minority	Pretest	722	42%	0.18	35%	43.92	<.0001	1.63
	Posttest	722	77%	0.13				
Multi-Racial	Pretest	53	42%	0.17	35%	13.46	<.0001	1.85
	Posttest	53	77%	0.11				

Table 4: Chemistry 1 Module 2: Atoms and Elements Comparison of Pretest and Posttest Percent Correct Scores Honors Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1511	45%	0.17	38%	79.09	<.0001	2.03
	Posttest	1511	83%	0.10				
Female	Pretest	889	45%	0.17	38%	60.92	<.0001	2.04
	Posttest	889	83%	0.10				
Male	Pretest	622	45%	0.17	39%	50.42	<.0001	2.02
	Posttest	622	84%	0.10				
FRL	Pretest	534	44%	0.17	38%	45.05	<.0001	1.95
	Posttest	534	82%	0.10				
Non FRL	Pretest	977	46%	0.17	39%	65.14	<.0001	2.08
	Posttest	977	84%	0.10				
White	Pretest	735	44%	0.17	40%	58.06	<.0001	2.14
	Posttest	735	84%	0.10				
Minority	Pretest	709	46%	0.18	37%	51.14	<.0001	1.92
	Posttest	709	83%	0.11				
Multi-Racial	Pretest	67	44%	0.17	39%	18.48	<.0001	2.26
	Posttest	67	84%	0.09				

Table 5: Chemistry 1 Module 3: Molecules and Compounds Comparison of Pretest and Posttest Percent Correct Scores Regular Students								
Group	Test	Number	Mean	Standard Deviation	Mean Difference	t-Test	Significance	Effect Size
All Students	Pretest	1493	37%	0.18	40%	72.68	<.0001	1.88
	Posttest	1493	77%	0.14				
Female	Pretest	821	38%	0.18	39%	53.97	<.0001	1.88
	Posttest	821	77%	0.14				
Male	Pretest	672	36%	0.17	41%	48.75	<.0001	1.88
	Posttest	672	77%	0.14				
FRL	Pretest	641	36%	0.18	40%	48.33	<.0001	1.91
	Posttest	641	76%	0.13				
Non FRL	Pretest	852	38%	0.18	40%	54.27	<.0001	1.86
	Posttest	852	78%	0.14				
White	Pretest	713	37%	0.18	41%	51.74	<.0001	1.94
	Posttest	713	78%	0.14				
Minority	Pretest	725	37%	0.18	39%	49.07	<.0001	1.82
	Posttest	725	76%	0.14				
Multi-Racial	Pretest	55	35%	0.19	42%	14.56	<.0001	1.96
	Posttest	55	77%	0.13				

Table 6: Chemistry 1 Module 3: Molecules and Compounds Comparison of Pretest and Posttest Percent Correct Scores Honors Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1499	39%	0.19	45%	86.77	<.0001	2.24
	Posttest	1499	84%	0.10				
Female	Pretest	879	39%	0.19	45%	66.28	<.0001	2.24
	Posttest	879	84%	0.10				
Male	Pretest	620	39%	0.19	45%	55.96	<.0001	2.25
	Posttest	620	84%	0.10				
FRL	Pretest	529	39%	0.19	44%	48.63	<.0001	2.11
	Posttest	529	83%	0.10				
Non FRL	Pretest	970	39%	0.19	46%	72.21	<.0001	2.32
	Posttest	970	85%	0.10				
White	Pretest	730	38%	0.19	47%	65.07	<.0001	2.41
	Posttest	730	85%	0.10				
Minority	Pretest	703	41%	0.19	43%	55.23	<.0001	2.08
	Posttest	703	84%	0.10				
Multi-Racial	Pretest	66	35%	0.19	49%	19.74	<.0001	2.43
	Posttest	66	84%	0.10				

Table 7: Chemistry 1 Module 4: Reactions Comparison of Pretest and Posttest Percent Correct Scores Regular Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1501	41%	0.20	40%	70.72	<.0001	1.83
	Posttest	1501	80%	0.14				
Female	Pretest	826	41%	0.19	40%	52.84	<.0001	1.84
	Posttest	826	80%	0.14				
Male	Pretest	675	40%	0.20	40%	46.99	<.0001	1.81
	Posttest	675	80%	0.13				
FRL	Pretest	640	40%	0.19	39%	45.13	<.0001	1.78
	Posttest	640	79%	0.14				
Non FRL	Pretest	861	41%	0.20	40%	54.47	<.0001	1.86
	Posttest	861	81%	0.14				
White	Pretest	721	41%	0.20	40%	49.07	<.0001	1.83
	Posttest	721	81%	0.14				
Minority	Pretest	728	40%	0.19	39%	49.07	<.0001	1.82
	Posttest	728	79%	0.14				
Multi-Racial	Pretest	52	36%	0.21	46%	14.00	<.0001	1.94
	Posttest	52	82%	0.12				

Table 8: Chemistry 1 Module 4: Reactions Comparison of Pretest and Posttest Percent Correct Scores Honors Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1482	45%	0.21	41%	74.17	<.0001	1.93
	Posttest	1482	87%	0.10				
Female	Pretest	872	46%	0.21	41%	56.87	<.0001	1.93
	Posttest	872	87%	0.10				
Male	Pretest	610	44%	0.21	42%	47.62	<.0001	1.93
	Posttest	610	86%	0.10				
FRL	Pretest	525	43%	0.20	42%	44.27	<.0001	1.93
	Posttest	525	85%	0.10				
Non FRL	Pretest	957	46%	0.21	41%	59.48	<.0001	1.92
	Posttest	957	87%	0.10				
White	Pretest	723	44%	0.21	43%	54.46	<.0001	2.03
	Posttest	723	87%	0.10				
Minority	Pretest	694	46%	0.21	40%	48.35	<.0001	1.84
	Posttest	694	86%	0.10				
Multi-Racial	Pretest	65	47%	0.20	38%	15.86	<.0001	1.97
	Posttest	65	86%	0.09				

Table 9: Chemistry 1 Module 5: Stoichiometry Comparison of Pretest and Posttest Percent Correct Scores Regular Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1274	38%	0.19	39%	61.95	<.0001	1.74
	Posttest	1274	77%	0.15				
Female	Pretest	665	39%	0.19	39%	43.78	<.0001	1.70
	Posttest	665	77%	0.15				
Male	Pretest	609	37%	0.18	40%	43.88	<.0001	1.78
	Posttest	609	77%	0.14				
FRL	Pretest	495	38%	0.19	37%	35.99	<.0001	1.62
	Posttest	495	75%	0.14				
Non FRL	Pretest	779	38%	0.19	41%	50.79	<.0001	1.82
	Posttest	779	79%	0.15				
White	Pretest	616	37%	0.18	42%	47.60	<.0001	1.92
	Posttest	616	78%	0.15				
Minority	Pretest	603	39%	0.20	37%	38.70	<.0001	1.58
	Posttest	603	76%	0.14				
Multi-Racial	Pretest	55	38%	0.18	40%	13.30	<.0001	1.79
	Posttest	55	77%	0.14				

Table 10: Chemistry 1 Module 5: Stoichiometry Comparison of Pretest and Posttest Percent Correct Scores Honors Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1236	41%	0.21	42%	66.93	<.0001	1.90
	Posttest	1236	83%	0.11				
Female	Pretest	726	42%	0.21	41%	50.79	<.0001	1.89
	Posttest	726	83%	0.11				
Male	Pretest	510	40%	0.21	43%	43.63	<.0001	1.93
	Posttest	510	83%	0.12				
FRL	Pretest	406	41%	0.21	40%	36.12	<.0001	1.79
	Posttest	406	81%	0.11				
Non FRL	Pretest	830	41%	0.21	43%	56.64	<.0001	1.97
	Posttest	830	84%	0.11				
White	Pretest	633	39%	0.20	44%	50.56	<.0001	2.01
	Posttest	633	83%	0.11				
Minority	Pretest	551	43%	0.21	40%	42.03	<.0001	1.79
	Posttest	551	83%	0.11				
Multi-Racial	Pretest	52	42%	0.22	42%	14.50	<.0001	2.01
	Posttest	52	84%	0.11				

Table 11: Chemistry 1 Module 6: Phases of Matter Comparison of Pretest and Posttest Percent Correct Scores Regular Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1294	41%	0.19	37%	61.19	<.0001	1.70
	Posttest	1294	78%	0.14				
Female	Pretest	676	42%	0.19	36%	43.53	<.0001	1.67
	Posttest	676	78%	0.14				
Male	Pretest	618	41%	0.20	37%	43.03	<.0001	1.73
	Posttest	618	78%	0.14				
FRL	Pretest	504	40%	0.19	36%	37.92	<.0001	1.69
	Posttest	504	76%	0.14				
Non FRL	Pretest	790	42%	0.19	37%	48.01	<.0001	1.71
	Posttest	790	79%	0.14				
White	Pretest	626	42%	0.20	37%	42.68	<.0001	1.71
	Posttest	626	79%	0.14				
Minority	Pretest	611	40%	0.18	36%	42.11	<.0001	1.70
	Posttest	611	76%	0.14				
Multi-Racial	Pretest	57	45%	0.18	34%	12.13	<.0001	1.61
	Posttest	57	79%	0.13				

Table 12: Chemistry 1 Module 6: Phases of Matter Comparison of Pretest and Posttest Percent Correct Scores Honors Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1248	46%	0.20	39%	63.60	<.0001	1.80
	Posttest	1248	85%	0.11				
Female	Pretest	738	46%	0.20	38%	49.35	<.0001	1.82
	Posttest	738	84%	0.11				
Male	Pretest	510	46%	0.21	39%	40.20	<.0001	1.78
	Posttest	510	85%	0.11				
FRL	Pretest	407	45%	0.20	38%	36.90	<.0001	1.83
	Posttest	407	83%	0.11				
Non FRL	Pretest	841	47%	0.21	39%	51.86	<.0001	1.79
	Posttest	841	86%	0.11				
White	Pretest	641	45%	0.20	40%	47.54	<.0001	1.88
	Posttest	641	85%	0.11				
Minority	Pretest	555	48%	0.20	37%	40.55	<.0001	1.72
	Posttest	555	84%	0.11				
Multi-Racial	Pretest	52	48%	0.22	37%	13.14	<.0001	1.82
	Posttest	52	85%	0.11				

Table 13: Chemistry 1 Module 7: Energy in Reactions Comparison of Pretest and Posttest Percent Correct Scores Regular Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1302	34%	0.16	39%	69.96	<.0001	1.94
	Posttest	1302	73%	0.14				
Female	Pretest	682	34%	0.16	39%	49.89	<.0001	1.91
	Posttest	682	73%	0.14				
Male	Pretest	620	33%	0.16	39%	49.05	<.0001	1.97
	Posttest	620	72%	0.14				
FRL	Pretest	510	33%	0.16	37%	40.82	<.0001	1.81
	Posttest	510	70%	0.14				
Non FRL	Pretest	792	34%	0.16	40%	57.33	<.0001	2.04
	Posttest	792	74%	0.14				
White	Pretest	633	34%	0.17	40%	51.66	<.0001	2.05
	Posttest	633	74%	0.14				
Minority	Pretest	612	33%	0.16	37%	45.13	<.0001	1.82
	Posttest	612	71%	0.14				
Multi-Racial	Pretest	57	34%	0.16	40%	15.41	<.0001	2.04
	Posttest	57	74%	0.13				

Table 14: Chemistry 1 Module 7: Energy in Reactions Comparison of Pretest and Posttest Percent Correct Scores Honors Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1233	37%	0.18	45%	83.73	<.0001	2.38
	Posttest	1233	81%	0.11				
Female	Pretest	730	37%	0.18	44%	63.07	<.0001	2.33
	Posttest	730	82%	0.11				
Male	Pretest	503	36%	0.17	45%	55.17	<.0001	2.46
	Posttest	503	81%	0.11				
FRL	Pretest	401	36%	0.17	44%	47.51	<.0001	2.37
	Posttest	401	80%	0.11				
Non FRL	Pretest	832	37%	0.18	45%	68.98	<.0001	2.39
	Posttest	832	82%	0.11				
White	Pretest	631	36%	0.17	45%	61.98	<.0001	2.47
	Posttest	631	81%	0.11				
Minority	Pretest	548	38%	0.18	44%	53.30	<.0001	2.28
	Posttest	548	82%	0.11				
Multi-Racial	Pretest	54	35%	0.17	44%	19.19	<.0001	2.61
	Posttest	54	79%	0.10				

Table 15: Chemistry 1 Module 8: Solutions Comparison of Pretest and Posttest Percent Correct Scores Regular Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1301	38%	0.19	47%	77.46	<.0001	2.15
	Posttest	1301	84%	0.11				
Female	Pretest	680	39%	0.20	46%	54.19	<.0001	2.08
	Posttest	680	85%	0.11				
Male	Pretest	621	36%	0.19	48%	55.54	<.0001	2.23
	Posttest	621	84%	0.11				
FRL	Pretest	507	37%	0.19	47%	49.22	<.0001	2.19
	Posttest	507	84%	0.11				
Non FRL	Pretest	794	38%	0.20	47%	59.82	<.0001	2.12
	Posttest	794	85%	0.12				
White	Pretest	628	38%	0.19	47%	55.05	<.0001	2.20
	Posttest	628	85%	0.11				
Minority	Pretest	615	37%	0.20	47%	51.97	<.0001	2.10
	Posttest	615	84%	0.12				
Multi-Racial	Pretest	58	37%	0.20	47%	16.53	<.0001	2.17
	Posttest	58	85%	0.10				

Table 16: Chemistry 1 Module 8: Solutions Comparison of Pretest and Posttest Percent Correct Scores Honors Students								
Group	**Test**	**Number**	**Mean**	**Standard Deviation**	**Mean Difference**	**t-Test**	**Significance**	**Effect Size**
All Students	Pretest	1219	40%	0.20	49%	80.87	<.0001	2.32
	Posttest	1219	89%	0.08				
Female	Pretest	720	41%	0.21	48%	60.67	<.0001	2.26
	Posttest	720	89%	0.08				
Male	Pretest	499	40%	0.19	49%	53.60	<.0001	2.40
	Posttest	499	89%	0.09				
FRL	Pretest	400	40%	0.20	48%	44.74	<.0001	2.24
	Posttest	400	88%	0.09				
Non FRL	Pretest	819	41%	0.21	49%	67.42	<.0001	2.36
	Posttest	819	90%	0.08				
White	Pretest	624	39%	0.19	50%	62.67	<.0001	2.51
	Posttest	624	90%	0.08				
Minority	Pretest	541	42%	0.21	47%	49.83	<.0001	2.14
	Posttest	541	89%	0.09				
Multi-Racial	Pretest	54	42%	0.20	46%	16.01	<.0001	2.18
	Posttest	54	88%	0.09				