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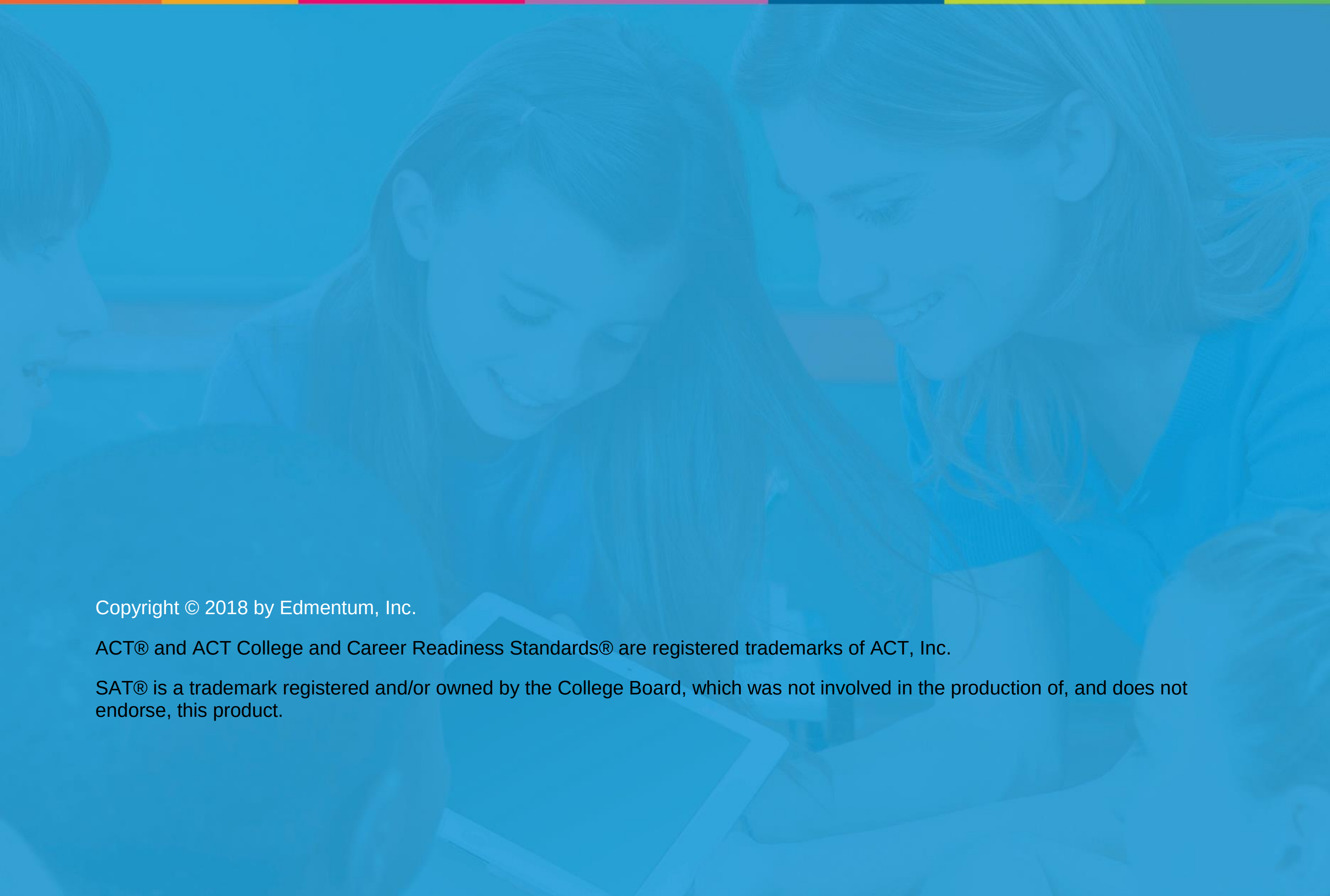
Research Report: ACT and the Use of Edmentum Test Packs in Support of ACT Preparation–An Oklahoma School District



Executive Summary

Edmentum Test Packs in Support of ACT Preparation is an assessment and curriculum tool that evaluates students against the ACT College and Career Readiness Standards®[1] and then provides instructional content in areas where students fail to demonstrate proficiency. It features a system of three comparable, fixed-form, diagnostic assessments that can be used over the course of a school year in combination with individualized prescriptions, or learning pathways, based on student assessment results that can be utilized by students in order to gain instruction and practice on standards tested by the ACT® test.

Located in the state of Oklahoma, the school district under investigation is an Edmentum partner that used Edmentum Test Packs in Support of ACT Preparation during the 2017–18 school year to structure instruction and prepare juniors for the ACT test. During this school year, the district enrolled more than 13,000 students in grades K–12, and requested support from the Edmentum Research team to examine the relationship between usage of Edmentum Test Packs in Support of ACT Preparation and student performance on the ACT test. As a public school organization in Oklahoma, the district participates in the state's accountability system. The Oklahoma Accountability System focuses on college and career readiness for all students and holds schools and districts accountable to a range of measures, including student achievement, graduation rate, attendance, and academic growth for all students, especially historically underperforming students. As part of this accountability, districts administer the Oklahoma College and Career Readiness Assessment (CCRA) to high school students, which includes the district's choice of the SAT®[2] or ACT test, thus fulfilling the federal accountability requirements for both high school ELA and math. ACT test data show that students from this Oklahoma district tend to perform at levels lower than the state average.

This study is intended to provide a research basis for Edmentum Test Packs in Support of ACT Preparation in terms of the research literature and analyses of the district's11th graders' level of usage and performance data within Test Packs compared to their performance on the ACT test. Hereafter, Edmentum Test Packs in Support of ACT Preparation is referred to as Test Packs for the sake of brevity.

Through a series of descriptive and correlational analyses, the findings in this study show that while most 11th graders i used the Test Packs assessments over the course of the school year, only a small proportion of students used the associated content designed to prepare students for the ACT test, and among those who did access the content, usage was low. Correlational analysis investigating the relationship between the Test Packs assessment score and the ACT score by subject found medium to large significant associations.

These analyses are clearly impacted by the quality and approach with which the district uses Test Packs. While there was a desire to examine the relationship between usage on Test Packs prescriptions and scores on the ACT test, low student usage made this analysis methodological and statistically indefensible. It is possible, given higher levels of student usage, that future research can examine this question in greater detail.

[1] ACT® and ACT College and Career Readiness Standards® are registered trademarks of ACT, Inc.

[2] SAT® is a trademark registered and/or owned by the College Board, which was not involved in the production of, and does not endorse, this product.

Introduction

Education is a key indicator for individual and societal progress. In her forward to the Organisation for Economic Cooperation and Development (OCED, 2012, p. 3) report, Barbara Ischinger states, “School failure penalises a child for life. . . .and imposes high costs on society.” At Edmentum, our mission is to be educators' most trusted partner in creating successful student outcomes everywhere learning occurs. Over the years, legislation has been enacted to provide federal guidance and requirements to states in support of improving educational outcomes. With modern legislation like No Child Left Behind (NCLB) of 2001 and the Every Student Succeeds Act (ESSA) of 2015, accountability of student achievement has been a critical focus. While ESSA continues to require states to assess students annually, the legislation now allows for some flexibility in the kinds of measures states may use, including measures of growth and of achievement. Specifically, assessments can now be “innovative” and include “multiple up-to-date measures of student academic achievement, including measures that assess higher-order thinking skills and understanding, which may include measures of student academic growth and may be partially delivered in the form of portfolios, projects, or extended performance tasks” (Every Student Succeeds Act, 2016).

This new flexibility around accountability measures, particularly in terms of growth, has increased the focus on educational products to support educators in delivering targeted instruction and programs to monitor student progress throughout the school year, with particular attention to progress relative to state assessment expectations of standards-based achievement.

The Oklahoma Accountability System focuses on college and career readiness for all students and holds schools and districts accountable to a range of measures, including student achievement, graduation rate, attendance, and academic growth for all students, especially historically underperforming students. To support schools, the Oklahoma State Department Education acts as a resource to support student achievement, where the focus includes standards, assessments, curriculum framework, instruction, and materials and resources (as well as safe and supportive schools). As part of this accountability, the Oklahoma School Testing Program (OSTP) administers assessments annually to students in grades 3 through 8 for English language arts (ELA) and math, as well as grades 5 and 8 for science, to assess the Oklahoma Academic Standards. For high school students, districts administer the College and Career Readiness Assessment (CCRA), which includes the district’s choice of the SAT or ACT test, fulfilling the federal accountability requirements for both high school ELA and math.

The district reported on in this paper is a current Edmentum partner located in Oklahoma that utilizes Test Packs to structure instruction and prepare juniors for the ACT test. The district requested support from the Edmentum Research team to examine the relationship between usage of Test Packs and student performance on the ACT test. In support of the district’s partnership with Edmentum, this study is intended to provide a research basis for Test Packs in terms of the research literature and analysis of students’ level of usage and performance data within Test Packs compared to their performance on the ACT test.

Literature Review

Formative and Diagnostic Assessment

Formative assessment is a process for monitoring progress and adjusting instruction as a result of the feedback (Heritage, 2010). Research on formative assessment and progress-monitoring practices has demonstrated positive outcomes for student achievement (Bangert-Drowns, Kulik, & Kulik, 1991; Black & Wiliam, 1998; Fuchs & Fuchs, 1986; January et al., 2018; Stecker, Lembke, & Foegen, 2008; Stiggins, 1999; Van Norman, Nelson, & Parker, 2016; Wolf, 2007), particularly for students with lower achievement (Black & Wiliam, 1998; January et al., 2018), as well as for building student confidence (Stiggins, 1999). Monitoring student progress is at the heart of such programs as curriculum-based measurement (CBM) (Deno, 1985; Fuchs & Fuchs, 1999), response to intervention (RTI), and the more recent movement to consider, RTI as part of a multi-tier system of supports (MTSS) (Gresham, Reschly, & Shinn, 2010).

Key to the success of monitoring progress is the action taken as a result of the feedback and information about progress that is provided (Duke & Pearson, 2002). Research shows that when an instructional feedback loop is applied in practice and instruction is modified based on student performance, student learning is accelerated and improved (Jinkins, 2001; Wiliam, Lee, Harrison, & Black, 2004), especially when feedback is applied quickly and impacts or modifies instruction on a day-by-day or minute-by-minute basis (Leahy, Lyon, Thompson, & Wiliam, 2005) and is used to provide students with opportunities to learn from the assessment (National Research Council, 2001).

Although generally providing feedback to teachers and students regarding student performance can consistently enhance achievement (Adams & Strickland, 2012; Baker, Gersten, & Lee, 2002; Chase & Houmanfar, 2009), meta-analytic research indicates that the timeliness and the type of feedback are critical within applied learning settings. Kulik and Kulik (1988) found that immediate feedback of results has a positive effect on student achievement within classroom settings, and Kulhavy and Stock (1989) found immediate feedback especially helpful when students were confident in their answers. Through their meta-analysis, Marzano, Pickering, and Pollock (2001) additionally concluded that feedback is best when it encourages students to keep working on a task until they succeed and tells students where they stand relative to a target level of knowledge instead of how their performance ranks in comparison to other students. Taken together, these results suggest that a cycle of ongoing feedback followed by remediation and further assessment contributes to increases in student achievement.

Considered by some educators to be a subset of formative assessment, diagnostic assessment is designed to assess students' current knowledge and identify any gaps in their understanding. While formative assessment typically takes place at the same time as instruction, diagnostic assessment specifically takes place before instruction has begun. After identifying gaps, diagnostic assessments are often specifically aimed at recommending actions students or educators can take to address these weaknesses (van der Kleij, Vermeulen, Schildkamp, & Eggen, 2015). A well-designed diagnostic assessment should help identify each student's learning needs and support the creation of targeted instruction plans (Jones, Conradi, & Amendum, 2016; Re, Pedron, Tressoldi, & Lucangeli, 2014; Schoppek & Tulis, 2010; Shepard, 2009). Indeed, diagnostic assessments are helpful only if their results can direct educators toward specific steps to close students' learning gaps (Shepard, 2009; Wiliam & Black, 1996).

Retrieval Practice and the Testing Effect

Beyond assessing student ability and identifying areas of weakness, formative and diagnostic assessments can also give students the opportunity to practice skills they will need for a later summative test, such as an end-of-year state test or a college-entrance test. Rawson and Dunlosky (2012) called practice testing "one of the most well-established strategies for improving student learning" (p. 419). In a practice testing situation, students perform *retrieval practice*, the process of retrieving information from their memories. Practice tests can be especially helpful when they challenge students. The effort to remember information helps solidify that information in students' long-term memory, ultimately helping them learn it better (Agarwal, Roediger, McDaniel, & McDermott, 2013; Rowland, 2014). This phenomenon is known as the *testing effect*: when students take a practice test before taking a final test, they perform better than students who do not take a practice test. In a meta-analysis of 217 separate studies that focused on practice testing in classrooms, Adesope, Trevisan, and Sundararajan (2017) found practice testing to be the most effective test-preparation strategy, more effective than any other study strategy. They concluded that teachers should use practice tests to "help students develop test-taking skills that may improve performance on high-stakes tests" (p. 688). In a similar meta-analysis of 159 studies, Rowland (2014) found that the "testing effect seems tied to the act of testing itself"; other types of re-exposure to the material do not work as well (p. 1434). Retrieval practice can also decrease test anxiety (Agarwal et al., 2013). Well-established research supports the effectiveness of "repeated, retrieval-based practice tests that are followed by restudy and that are distributed across time", referred to as *distributed test–restudy* (Rawson & Dunlosky, 2012, p. 421).

The Role of Technology

Although most of the research literature has focused on the effect of teacher-provided feedback or feedback from classroom-based assessments, research has shown that computers are also effective tools for providing feedback (Adams & Strickland, 2012). In their meta-analysis, Baker et al. (2002) concluded that although using computers to provide ongoing progress-monitoring feedback was effective (effect size [ES] = 0.29), using a computer to provide instructional recommendations based on these results was even more effective (ES = 0.51), suggesting that combining the two factors may be the most beneficial practice.

Technology-based programs such as Edmentum Test Packs Assessments that immediately utilize student performance data can also shift instruction or practice to the appropriate level required by a student to ensure more effective practice and to meet individual needs. Such personalization of instructional materials promotes learning through a reduction of the cognitive load (i.e., working memory activity) required to complete a task (Kalyuga & Sweller, 2005), and research from a variety of learning environments shows that personalized instruction can lead to more efficient training and higher test performance than fixed-sequence, one-size-fits-all programs (Camp, Paas, Rikers, & van Merriënboer, 2001; Corbalan, Kester, & van Merriënboer, 2006; Kalyuga & Sweller, 2005; Salden, Paas, Broers, & van Merriënboer, 2004).

Research Questions

This study seeks to understand student usage of Test Packs in an Oklahoma school district and what association, if any, exists between students' use of Test Packs assessments and prescriptions and their performance on the ACT test. Specifically, this study seeks to answer the following research questions:

1. What are the trends and patterns in this Oklahoma district's' student usage and performance on Test Packs assessments during the 2017–18 school year?

2. How is performance on Test Packs assessments correlated with performance on the ACT by subject among the district's 11th grade students?

3. What are the trends and patterns in student usage on Test Packs prescriptions during the 2017–18 school year?

To answer these research questions, descriptions of Test Packs and the ACT test as used in Oklahoma are provided. This section is followed by an analysis of student usage of Test Packs assessments and a correlational analysis of the relationship between Test Packs assessments and ACT performance. Finally, we examine the use of Test Packs prescriptions, which are generated based on student results on the Test Packs assessments.

Components of Test Packs

Test Packs are a combination of assessments and instructional materials that are aligned to ACT content and standards, referred to as Test Packs assessments (or assessments) and Test Packs prescriptions (or prescriptions). Test Packs assessments consist of a series of three comparable, fixed-form assessments for each ACT subject, which can be administered over the course of a school year, and they are designed to provide an evaluation of students' readiness for the ACT test within that subject. Assessment items are aligned to ACT reporting categories and associated standards. Table 1 shows the item counts on each of the three forms of the assessments by subject and reporting category. These item counts by subject and reporting category are identical to those found on the ACT test, so each Test Packs assessment serves as a practice test for the ACT test.

Table 1. Reporting Categories and Item Counts for Test Packs Assessments

Subject	Reporting Category	Item Count
English	Production of Writing	24
	Knowledge of Language	12
	Conventions of Standard English	39
	Total	**75**
Math	Preparing for Higher Mathematics	36
	· Number and Quantity	4
	· Algebra	9
	· Functions	9
	· Geometry	9
	· Statistics and Probability	5
	Integrating Essential Skills	24
	Total	**60**
Reading	Key Ideas and Details	23
	Craft and Structure	11
	Integration of Knowledge and Ideas	6
	Total	**40**
Science	Interpretation of Data	20
	Scientific Investigation	8
	Evaluation of Models, Inferences, and Experimental Results	12
	Total	**40**

Once a student completes an assessment, Test Packs automatically prescribe instructional content in areas where individual student results suggest remaining learning gaps. Alternatively, teachers can make manual adjustments to student assignments. Automatic learning paths result in differentiated instructional and learning goals by student based on areas of need. In addition to the assessments and instructional content found within prescriptions, students and teachers can access reports that show information about the academic progress of individuals students and classroom from one test to another and that pinpoint student knowledge gaps and identify where students need additional instruction, giving teachers information that can be used to guide and inform instruction.

Oklahoma College and Career Readiness Assessment for High School Students (CCRA)

In order to meet federal accountability requirements, each state is required to assess students, with a mandate that students are tested once during high school in math, reading, and science. With the 2015 reauthorization of the Elementary and Secondary Education Act (ESEA), known as the Every Student Succeeds Act (ESSA), districts could, with state approval, opt to use a locally selected, nationally recognized college- and career-ready test instead of a state-specific exam, including the ACT and SAT assessments.

The state of Oklahoma has chosen to meet federal accountability requirements by requiring 11th grade students to take the College and Career Readiness Assessment (CCRA), consisting of two parts, to demonstrate academic achievement status. For the first portion, each district can choose between administering the ACT or SAT test, including the writing section. For the second part, students take the Science Content Assessment, which is aligned to the Oklahoma Academic Standards of Science, and the U.S. History Assessment, which is aligned to the Oklahoma Academic Standards for U.S. History. Results of these assessments allow districts to evaluate the quality of college and career preparedness their schools are providing to students. This district in this paper has,chosen to use the ACT test to fulfill the first requirement of the CCRA.

Of particular interest to this study, the ACT test, a national standardized assessment, is traditionally used for college admissions and evaluates four main content areas: English, mathematics, reading, and science. The ACT assessment also includes writing as a fifth subject area, which is typically optional. However, in order for the ACT test to meet the requirements of Oklahoma's CCRA, the writing portion must be administered. Each of the four core content areas is evaluated and given a score on a scale from 1 to 36, and the scores are then averaged into a composite score. The writing portion of the ACT test consists of an essay test that is evaluated and scored separately on a scale from 2 to 12 across four different domains, consisting of ideas and analysis, development and support, organization, and language use and conventions. The number of items administered within ACT test's four main content areas by reporting category is shown in Table 2 (ACT, 2017b)

Table 2. Reporting Categories and Item Counts for ACT Test

Subject	Reporting Category	Item Count
English	Production of Writing	22-24
	Knowledge of Language	11-13
	Conventions of Standard English	39-41
	Total	**75**
Math	Preparing for Higher Mathematics	34–36
	· Number and Quantity	4–6

	· Algebra	7–9
	· Functions	7–9
	· Geometry	7–9
	· Statistics and Probability	5–7
	Integrating Essential Skills	24–26
	Modeling[a]	≥16
	Total	**60**
Reading	Key Ideas and Details	22–24
	Craft and Structure	10–12
	Integration of Knowledge and Ideas	6–7
	Total	**40**
Science	Interpretation of Data	18–22
	Scientific Investigation	8–12
	Evaluation of Models, Inferences, and Experimental Results	10–14
	Total	**40**

[a]The items measuring proficiency on the modeling reporting category are integrated into each the other mathematics reporting categories, not as separate items.

District ACT Performance

Using data provided by the district, Table 3 reports the ACT performance of the juniors by subject based on the April 2018 administration. Oklahoma state data is also included in Table 3 as a point of comparison, though this data is based on the 2017 graduating class, the most recently available data (ACT, 2017a). For Oklahoma state, ACT performance was reported for 2017 graduates, who took the ACT test as sophomores, juniors, or seniors, with the most recent test used in reporting for students who took the assessment more than once. Although the data are not entirely comparable, they give a relative sense of performance between the district students and the state as a whole. The average composite ACT scores for the district 11th graders range from 15.5 in English to 17.5 in Reading, compared to the Oklahoma state range of 18.5 to 20.1. Subject scores among the juniors are on average 2.6 to 3 points lower than in the state as a whole. Standard deviations (SD), though included in Table 3 for the district's students, were not available for Oklahoma state.

Table 3. Descriptive Statistics for 2018 ACT Scores of District and Oklahoma State

	District				Oklahoma[a]		
Subject	**N**	**Mean**	**Median**	**SD**	**N**	**Mean**	**Median**
English	1,162	15.50	15.00	4.92	42,405	18.50	18.00
Math	1,162	16.13	15.00	2.86	42,405	18.80	17.00
Reading	1,160	17.48	16.00	5.61	42,405	20.10	20.00
Science	1,159	16.87	17.00	4.36	42,405	19.60	19.00
Composite	1,159	16.63	16.00	3.84	42,405	19.40	19.00

Note. N = number of students tested.
[a]Data for Oklahoma from ACT (2017a).

As a measure of college readiness, ACT has determined a benchmark score within each subject, which is defined as the minimum score needed to signify that a student is sufficiently prepared for a first-year college course in that content area. Table 4 reports the benchmark scores by content area, as well as the percent of students meeting that benchmark across the state of Oklahoma and within the district. (ACT, 2017a). Compared to Oklahoma state, smaller proportions of the district 11th grade students are meeting benchmark criteria across every area, including only 7% in math to 31% in English compared to 26% to 52% in the state as a whole. In total, 3% of the district's 11th graders attained benchmark scores in all subject areas, compared to 16% of Oklahoma students statewide.

Table 4. Percent Achieving ACT College Readiness Benchmark Scores, Oklahoma District and Oklahoma State

Subject	**ACT Benchmark Score**	**Students Meeting ACT Benchmark, District (%)**	**Students Meeting ACT Benchmark, Oklahoma (%)[a]**
English	18	31	52
Math	22	7	26
Reading	22	23	39
Science	23	10	26
All Four Subjects		3	16

[a]Data for Oklahoma from ACT (2017a).

Sample

This study was conducted on a convenient sample of students from an Oklahoma district, an Edmentum partner during the 2017–18 school year. The district provided student-level ACT test data from the spring 2018 administration and demographic information for this study. The data were then matched to Test Packs assessments and prescription data via unique student identifiers. While district students across multiple grade levels used Test Packs, this study focuses on 11th graders who all took the ACT test during a statewide testing period in April 2018, in order to fulfill federal accountability requirements as described previously.

As with any sample, it is important to understand how well the sample might generalize to other samples or the population overall. Data from the Oklahoma State Department of Education (2017) in Table 5 show that the district's students are more likely to be white or American Indian compared to the statewide population of students and slightly less likely to be enrolled in special education through an Individualized Education Program (IEP). Table 6 provides the demographic makeup of both the sample of 11th graders for this study who used Test Packs and the school's entire population of 11th graders. The demographics of the 11th grade sample of students using Test Packs appear to be comparable to the school as a whole.

Table 5. District Demographics Compared to State

Demographic Characteristic	School (%)	State (%)	Difference (District vs. State)
Individualized Education Program (IEP)[a]	13.4	15.7	-2.3
Hispanic[b]	8.1	17.2	-9.1
Black[b]	4.6	8.6	-4.0
White[b]	67.9	48.9	19.1
Asian[b]	0.5	2.0	-1.5
American Indian/Alaska Native[b]	18.5	13.6	4.9
Hawaiian/Pacific Islander[b]	0.3	0.4	-0.1
Two or More Races[b]	0.1	9.3	-9.2

[a]Data from Oklahoma State Department of Education-Special Education Services (2018).
[b]Data from Oklahoma State Department of Education (2017).

Table 6. Sample Demographics of Test Packs Users and District Students

		District Juniors ACT		District Juniors Test Packs	
Variable	**Value**	**N**	**%**	**N**	**%**
Individualized Education Program (IEP)	No	1,034	89	862	88
	Yes	131	11	116	12
Economically Disadvantaged	No	430	37	360	37
	Yes	735	63	618	63
English Language Learner (ELL)	No	1,156	99	969	99
	Yes	9	1	9	1
Race / Ethnicity	American Indian / Alaskan Native	186	16	167	17
	Asian / Pacific Islander	7	1	5	1
	Black / African American	87	7	73	7
	Hispanic / Latino	126	11	103	11
	Multiracial	8	1	6	1
	White	751	64	624	64
Total		1,165	100	978	100

Note. N = number of students

Definition of Usage

To evaluate just how much the school is using Test Packs, "usage" is defined in terms of two participatory factors: Test Packs assessments (or assessments) and Test Packs prescriptions (or prescriptions). In this paper, usage is defined differently for assessments and prescriptions.

Assessments

Assessments offer three fixed-form formative assessments for each ACT subject that are aligned to the ACT College and Career Readiness Standards and built following the blueprints for each content area. These assessments vary in length, ranging from 40 items in science and reading to 75 items in English, with the number of items and coverage across standards identical to what students experience on the ACT test, making each assessment both an evaluation of student preparedness and an opportunity for a practice test. Test Packs assessments are designed to be taken periodically throughout the school year. The close alignment between the ACT test and Test Packs suggests that assessment results may be predictive of how prepared students could be for the ACT test. For assessments, student usage is defined as the completion of a Test Packs form.

Prescriptions

Once as assessment is completed, a learning prescription is automatically generated for each student based on assessment results and designed to give the student the opportunity for instructional content that, if utilized, gives the student the opportunity for instruction and practice in areas of weakness. For this study, usage in prescriptions is defined as completing a lesson in which a student receives instruction, answers practice questions, and takes a short mastery test. Students who complete at least one lesson are considered prescription users. All other students who have completed Test Packs assessment but who have not worked on their assigned prescriptions are considered nonusers.

Analysis: Test Packs Assessments

Research Question 1: What are the trends and patterns in the district's student usage and performance on Test Packs assessments during the 2017–18 school year?

Table 7 shows the total number of unique 11th grade students using Test Packs materials compared to the total number of juniors enrolled in the Oklahoma district. While the second column shows the counts of 11th graders in the district, the third and fourth sets of columns show the students who were users of Test Packs assessments, differentiated in the following way: the third set of columns shows the group of students who took any assessment during the 2017–18 school year, and the fourth set of columns shows the group of students who took an Edition 2 or Edition 3 assessment.

By way of background, Test Packs Edition 1 was replaced by Test Packs Edition 2 in late August 2017. Edition 2 was an updated version of Test Packs, aligned to new ACT blueprints and standards. However, due to the timing of the Edition 2 release, the district decided to begin its earlier August school year using Edition 1 and continued using Edition 1 into the fall after Edition 2 was released in order to avoid confusion among teachers and students. Test Packs Edition 3, which made only very minor changes to the math assessment, was released in January 2018. Differences between Edition 2 and Edition 3 only exist in math and were limited to four items on the assessment forms that needed to be replaced when additional details on ACT standards were released. From here on in the paper, they will be referred to as Edition 2/3.

Table 7. Number of ACT Juniors Participating in Test Packs Assessments

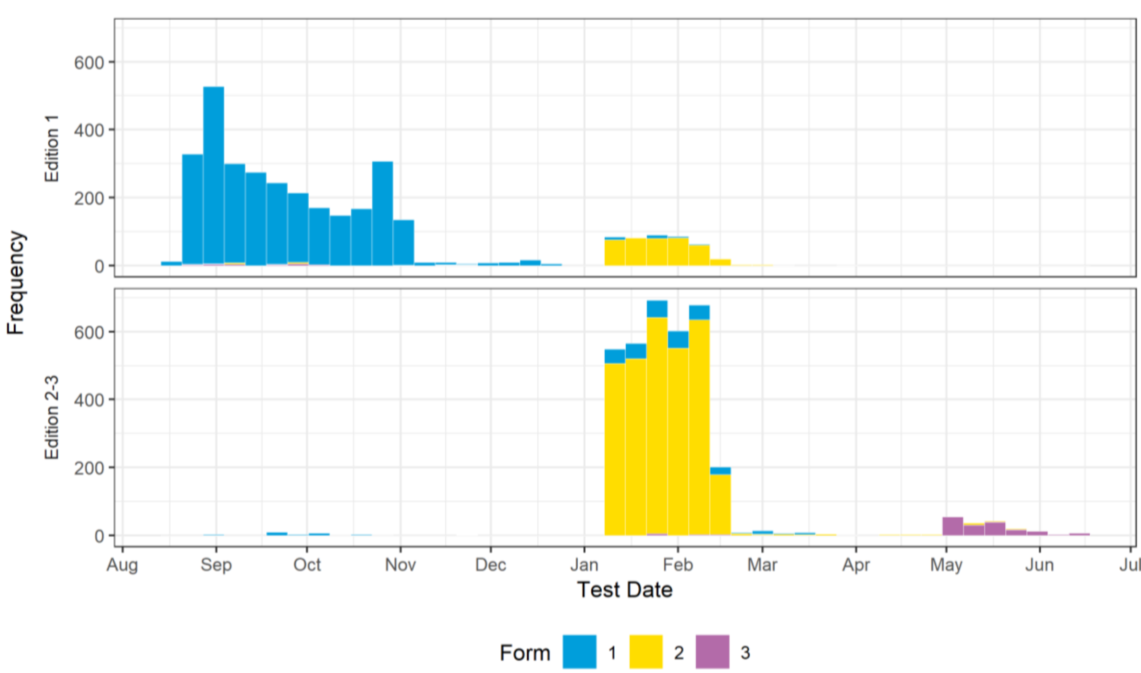
	District Juniors	Test Packs Users		Test Packs Users (Ed. 2/3)	
Subject	**N**	**N**	**%**	**N**	**%**
English	1,162	971	84	839	72
Math	1,162	974	84	845	73
Reading	1,160	973	84	836	72
Science	1,159	965	83	845	73
Any Subject	1,165	978	84	868	75

Note. N = number of students

Table 7 shows that a large proportion of the district's juniors, 978 out of 1165 total students, or 84%, took an assessment in at least one subject of any edition. The proportion of users for all subjects is similar, and further data analysis shows that 98% of the Test Packs users took assessments in all ACT four subjects. Furthermore, 75% of 11th grade students took an Edition 2/3 Test Packs assessment in at least one subject.

Figure 1 provides the timing of the assessments over the course of the school year by edition and form, and it shows that Edition 1, Form 1 was widely used from August to October 2017, with some limited use of Edition 1, Form 2 in January and February 2018. Edition 2, particularly Form 2, begins to be used in earnest across the district in January and February 2018. Because the juniors were required to take the ACT test in the spring, the district did not assign them to take Form 3 during the same period, and Figure 1 clearly shows the very low numbers of students taking Form 3 at the end of the school year. Additional exploration of the data shows that 70% of the district's juniors complete at least two assessments within a subject during the course of the school year. Appendix A reports the volume and time period of administrations of all assessments by subject, edition, and test form.

Figure 1. Distribution of 2017-18 Test Packs Dates by Edition and Form, District 11th Graders



Because of the tight alignment between current ACT standards and Test Packs in Edition 2/3, the assessment sections of this paper will focus primarily on assessment data from Edition 2/3 and will not include assessment data from Edition 1. Table 8 reports descriptive statistics for student performance on Test Packs assessments for Forms 1–3, Edition 2/3. The maximum possible score for the assessments is 40 for reading and science, 60 for math, and 75 in English. Mirroring what was reported earlier, Table 8 shows that the largest group of students took Form 2 across all subjects, with substantially fewer students taking Forms 1 and 3.

Table 8. Test Packs Assessment Raw Score Descriptive Statistics

Subject	Form	N	Questions	Min	Max	Mean	SD
English	1	79	75	0	55	32.05	12.82
	2	757	75	0	58	31.00	11.31
	3	45	75	11	61	31.64	12.10
Math	1	85	60	0	37	18.58	7.20
	2	762	60	0	55	17.23	6.92
	3	38	60	3	34	14.63	6.50
Reading	1	70	40	0	32	17.29	6.88
	2	766	40	2	36	17.07	6.80
	3	41	40	4	21	10.68	3.62
Science	1	66	40	6	33	15.02	6.29
	2	771	40	0	32	14.71	6.01
	3	53	40	6	27	14.11	5.24

Note. N = number of students

In general, the mean assessment raw scores are low, ranging from 24% in math, Form 3 to 42% in English, Form 1. Given the relatively small group of students using Forms 1 and 3, an examination of the performance trends across the school year is not appropriate. Additionally, it is important to keep in mind that, while the Test Packs forms have been designed to be comparable in content, item type, and standards coverage across forms, they have not been statistically equated and thus, may vary in difficulty from form to form. Due to the low volume of students taking Forms 1 and 3, Edition 2/3, we only include the results from assessment Form 2 for the correlational analysis, and our sample is based on students with reported scores for Form 2, as well as 2018 ACT scores. Assessment *z* scores were calculated from raw scores, and these are provided, along with descriptive data for the matched ACT scores and the final sample size for the correlational analysis, in Table 9. The mean ACT subject scores for the group of students in the analytic sample are very similar to the mean ACT subject scores for the entire group of 11th graders shown earlier in Table 3.

Table 9. Sample Sizes and Descriptive Statistics for Test Packs Assessment Data Analysis

		Test Packs *z* Score				ACT Scale Score			
Subject	**N**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**
English	757	-2.74	2.39	0.00	1.00	5	34	15.66	5.05
Math	762	-2.49	5.46	0.00	1.00	4	32	16.16	2.98
Reading	766	-2.22	2.78	0.00	1.00	4	36	17.55	5.68
Science	771	-2.45	2.88	0.00	1.00	5	34	16.98	4.41

Note. N = number of students

Research Question 2: How is performance on Test Packs assessments correlated with performance on the ACT subject tests among the district's 11th grade students?

When the alignment of learning standards and assessments is sound, then there is a greater likelihood that one test score may predict another. The relationship between the two test scores can be called *predictive* or *criterion validity*. *Predictive validity* can be investigated by calculating the correlation coefficient between the results of the assessment and the subsequent targeted outcome—in this case the ACT test. The stronger the correlation between the assessment data and the targeted outcome, the greater the degree of predictive validity the assessment possesses. Furthermore, when a correlation is statistically significant at the .05 level or lower, the probability of obtaining such a correlation coefficient by chance would occur fewer than 5 times out of 100, giving us confidence that a relationship between the two test scores does exist.

The correlations between assessment scores and the ACT scores provide evidence of the predictive validity of Test Packs assessment to the ACT test. Correlation coefficients range from 0 to +/-1, and they are interpreted such that the larger the correlation coefficient, the stronger the association between the two assessments. The interpretation is that the highly correlated assessments likely measure similar constructs or indicate what Messick (1989) referred to as convergent validity and may predict one from the other.

As with any statistic, there are assumptions about the data to consider before trusting the correlations. Specifically, the data should be normally distributed, linear, and homoscedastic (the errors are random and variances are similar across variables). In situations where assumptions are violated, the correlation may become inadequate to explain a given relationship. In this study, none of the test scores was normally distributed. Therefore, the Spearman rank correlation coefficients are provided rather that the Pearson correlation coefficients. Spearman's *rho* is a nonparametric statistic that does not require normally distributed data and is interpreted in similar fashion to other types of correlations. See Appendix B for a table displaying the results of all tests for normal distributions of the ACT test and Test Packs assessments scores and Appendix C for histograms showing a visual representation.

Table 10 provides the Spearman's *rho* correlations between Test Packs assessment *z* scores and the ACT scores by subject. Scatterplots of these correlations are provided in Appendix D.

To understand the magnitude of the association, Cohen, Cohen, West, and Aiken (2003) provided a standard or rule of thumb for interpreting the strength of the relationship. Correlation coefficients between 0.10 and 0.29 represent a small association, coefficients between 0.30 and 0.49 represent a medium association, and coefficients of 0.50 and above represent a large association or relationship. As Table 10 shows, there is a large, positive, and significant correlation between students' performance on Test Packs assessments and their performance on the ACT test in English, reading, and science, with correlation coefficients ranging from .538 to .634. In math, the correlation coefficient does not quite meet the standard for a large association, but at .485, it is a statistically significant high medium association. The scatterplot in Appendix D for math shows more existing outliers than other subjects: some students who scored at high levels on the ACT test performed at low levels on the Test Packs Assessment, and vice versa. It is unclear why these outliers exist in math more than in other subjects.

Table 10. Correlation Between Scores on ACT Test and Test Packs Form 2 Assessment by Subject

Subject	Spearman's *rho*	*p* Value
English	0.538***	0.000
Math	0.485***	0.000
Reading	0.634***	0.000
Science	0.564***	0.000

***Statistically significant at the .001 level

Research Question 3: What are the trends and patterns in student usage on Test Packs prescriptions?

As discussed earlier, students are considered users of Test Packs prescriptions when they use any of the instructional materials automatically assigned after an assessment. Table 11 shows the total number of unique 11th grade students using Test Packs prescriptions compared to the total number of juniors enrolled in the district. This is similar to Table 7, which shows the counts and percentages of students using assessments, but for prescription users. While the second column shows the counts of district 11th graders, the third and fourth sets of columns show the students who were users of Test Packs prescriptions, differentiated in the following way: the second set of columns shows the group of students who used prescriptions based on any Test Packs Assessment during the 2017–18 school year, and the third set of columns shows the group of students using prescriptions based on an Edition 2/3 assessment. In contrast to the assessments with a large proportion of the district juniors completing assessment forms, Table 11 shows that a minority of students used any of the prescription material assigned upon completion of an assessment. By subject, 18% to 22% used prescriptions based on assessments from any edition, while 8 to 10% of students used prescriptions based on Edition 2/3 assessments. Furthermore, 30% of students used some prescription materials in at least one subject.

Table 11. Number of ACT Juniors Participating in Test Packs Prescriptions

	District Juniors	Prescriptions Users		Prescriptions Users (Ed. 2–3)	
Subject	**N**	**N**	**%**	**N**	**%**
English	1,162	212	18	97	8
Math	1,162	252	22	119	10
Reading	1,160	215	19	102	9
Science	1,159	215	19	103	9
Any Subject	1,165	355	30	187	16

Note. N = number of students

Previously, we examined the correlational relationship between performance on Test Packs assessments and the ACT test and limited our data to assessments only from Edition 2/3 because of the alignment between the assessments. Here, we are more concerned about overall student usage and engagement in the prescriptions throughout the entire school year, so we do not restrict our analysis to prescription use that was tied to Edition 2/3. Instead, we pool the assessment editions together to understand better the amount of student usage in the prescriptions. To gauge the amount of student usage, we consider several measures, including the number of lessons completed compared to the lessons assigned and the amount of time spent.

Table 12 shows descriptive information for the number of lessons assigned by each assessment form taken, compared to the lessons completed by the 11th graders over the course of the 2017–18 school year. The "Total" row for each subject shows the descriptive statistics for the year-long summed total by student, while the "Sum" column provides the lessons assigned and completed aggregated over all students. The "Completion Rate" in the final column is the total number of lessons completed divided by the total lessons assigned. For example, for English Form 1, 718 lessons were completed, while 6,733 were assigned, giving a completion rate of 11%.

Because of the variety of standards covered in math, as well as the algorithms that produce the prescription assignments, math has the potential for the most lessons assigned. This is apparent by looking at the average assigned modules. For math, students were assigned on average 36 to 40 lessons per assessment, contrasting with 7 to 9 in English, 10 to 16 in reading, and 6 to 8 in science. The mean number of completed lessons is quite small across every group. Looking at the totals by subject, students complete an average of one lesson in English, reading, and science and the lessons in math during the entire school year. The median values for lessons completed within every group are zero, reflecting the earlier finding within the subject, that more than three-quarters of students do no work at all within their prescriptions.

Table 12. Descriptive Statistics for the Total Number of Lessons Assigned and Total Number of Lessons Completed, Test Packs Prescriptions

			Assigned Modules						Completed Modules						Completion Rate (%)
Subject	**Form**	**N**	**Min**	**Median**	**Max**	**Mean**	**SD**	**Sum**	**Min**	**Median**	**Max**	**Mean**	**SD**	**Sum**	
English	1	746	1	9.0	23	9.03	3.35	6,733	0	0	20	0.96	2.56	718	11
	2	860	2	9.0	23	8.82	2.71	7,583	0	0	15	0.61	2.07	524	7
	3	48	1	6.5	19	6.77	2.49	325	0	0	7	0.60	1.83	29	9
English Total		971	2	15.0	55	15.08	6.03	14,641	0	0	25	1.31	3.45	1,271	9
Math	1	756	8	35.0	94	36.45	11.15	27,559	0	0	69	2.18	7.01	1,651	6
	2	857	5	38.0	101	37.46	8.66	32,106	0	0	82	1.80	7.07	1,543	5
	3	43	23	40.0	105	40.12	12.96	1,725	0	0	42	2.05	8.07	88	5
Math Total		974	13	67.0	267	63.03	23.31	61,390	0	0	123	3.37	10.92	3,282	5
Reading	1	750	1	11.0	30	11.44	4.11	8,577	0	0	25	1.04	2.90	779	9
	2	853	1	10.0	37	10.34	4.41	8,820	0	0	23	0.67	2.39	570	7
	3	45	11	16.0	39	16.36	4.37	736	0	0	16	0.84	3.23	38	5
Reading Total		973	1	18.0	97	18.64	8.95	18,133	0	0	34	1.43	3.99	1,387	8
Science	1	712	1	7.0	22	7.17	2.56	5,107	0	0	17	1.01	2.42	719	14
	2	854	1	6.0	28	5.52	1.80	4,713	0	0	12	0.40	1.40	341	7
	3	54	3	7.0	27	8.07	4.73	436	0	0	7	0.46	1.61	25	6
Science Total		965	1	11.0	72	10.63	5.55	10,256	0	0	19	1.12	2.79	1,085	11

Note. N = number of students

Table 13 provides additional information about student usage within the prescriptions by reporting the amount of time spent working on prescription content by assessment and subject. In total, the average amount of time spent within prescriptions over the course of the full school year ranges from 37 minutes in science to almost two hours in math. Both Table 12 and Table 13 show that, for the most part, the district students did not spend much time or effort working on Test Packs prescriptions.

Table 13. Descriptive Statistics for Total Amount of Time (Minutes), Test Packs Prescriptions

Subject	Form	N	Min	Median	Max	Mean	SD
English	1	746	0.00	0.00	951.85	35.16	108.63
	2	860	0.00	0.00	973.45	17.54	77.75
	3	48	0.00	0.00	223.87	15.62	48.88
English Total		971	0.00	0.00	1,170.00	43.32	129.82
Math	1	756	0.00	0.00	5,476.27	86.12	347.38
	2	857	0.00	0.00	5,140.12	58.76	284.87
	3	43	0.00	0.00	588.80	20.10	92.35
Math Total		974	0.00	0.00	6,956.97	119.44	455.25
Reading	1	750	0.00	0.00	1,412.12	38.49	127.15
	2	853	0.00	0.00	1,187.18	23.26	99.80
	3	45	0.00	0.00	206.68	15.50	47.86
Reading Total		973	0.00	0.00	2,351.35	50.78	164.88
Science	1	712	0.00	0.00	1,013.13	31.12	93.38
	2	854	0.00	0.00	1,095.05	15.12	74.80
	3	54	0.00	0.00	340.90	9.53	49.01
Science Total		965	0.00	0.00	1,430.73	36.88	122.21

Note. N = number of students

Conclusions and Future Research

Our research findings show that large proportions of the Oklahoma district's 11th graders completed Test Packs assessments multiple times during the course of the school year, with high volumes in the fall and winter. This usage aligned with the district's implementation plan. However, most students did not complete any work at all on their prescriptions, the learning modules designed to provide instruction and practice in areas aligned to the ACT College and Career Readiness Standards, in which they showed learning gaps. Overall time spent on prescription content and lessons completed was low across the student population. While we expect that completing practice tests with Test Packs can help students prepare for the ACT test, a significant benefit of the program is not achieved when students do not use prescription content to address weak areas. This would be of particular advantage to the district students, who on average are performing at lower levels on the ACT test than students overall in Oklahoma.

Additionally, although we were only able to consider Form 2, we find medium to large statistically significant correlations between student performance by subject on Test Packs assessments and their later performance on the ACT test, providing evidence of predictive validity.

Data limitations prevented us from examining additional questions. In addition to correlational analysis on Form 2, we could also examine the predictive relationship between these forms and the ACT test given sufficient volume on Forms 1 and 3, although given the district's implementation plan, the system of district may not choose to administer Form 3 to school 11th graders.

Of particular interest to the district is the relationship between using instructional content assigned through prescriptions and student performance on the ACT test. This is a research question that can be investigated in the future, given two distinct and separate issues that need to be addressed. First, from an implementation perspective, students must be using the prescriptions at a higher level than they were during the 2017–18 school year. Additionally, from a technical perspective, a pretest measure of student ability is needed in order to take into account differences in student ability across user groups. That is to say, if students using Test Packs prescriptions are generally higher-ability students, they are likely to do better on the ACT test regardless of whether or not they are using Test Packs prescriptions. Future research can investigate the association between using prescriptions and ACT performance by comparing students with similar ability across user groups.

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Appendix A. Volume of Test Packs Assessment Use by Subject, Edition, Test Form, and Administration Date

Assessment Title	N	Earliest Date	Latest Date
ACT English and Writing Test 1 - Edition 1	723	2017-08-18	2018-02-01
ACT English and Writing Test 1 - Edition 2	62	2017-08-31	2018-03-15
ACT English and Writing Test 1 - Edition 3	17	2018-01-29	2018-02-21
ACT English and Writing Test 2 - Edition 1	116	2017-08-23	2018-03-01
ACT English and Writing Test 2 - Edition 2	682	2018-01-08	2018-04-23
ACT English and Writing Test 2 - Edition 3	77	2018-01-30	2018-05-22
ACT English and Writing Test 3 - Edition 1	5	2017-08-23	2017-11-02
ACT English and Writing Test 3 - Edition 2	2	2018-01-22	2018-05-16
ACT English and Writing Test 3 - Edition 3	43	2018-02-09	2018-06-11
ACT Math Test 1 - Edition 1	728	2017-08-18	2018-03-27
ACT Math Test 1 - Edition 2	70	2017-09-18	2018-03-15
ACT Math Test 1 - Edition 3	15	2018-01-29	2018-05-23
ACT Math Test 2 - Edition 1	108	2017-08-24	2018-03-08
ACT Math Test 2 - Edition 2	686	2018-01-08	2018-04-20
ACT Math Test 2 - Edition 3	78	2018-01-30	2018-05-15
ACT Math Test 3 - Edition 1	6	2017-08-24	2017-11-16
ACT Math Test 3 - Edition 2	2	2018-01-22	2018-05-11
ACT Math Test 3 - Edition 3	36	2018-05-02	2018-06-11
ACT Reading Test 1 - Edition 1	733	2017-08-17	2018-02-07
ACT Reading Test 1 - Edition 2	57	2017-09-21	2018-03-15
ACT Reading Test 1 - Edition 3	13	2018-01-29	2018-02-13
ACT Reading Test 2 - Edition 1	102	2017-08-29	2018-03-01
ACT Reading Test 2 - Edition 2	688	2017-11-22	2018-04-23
ACT Reading Test 2 - Edition 3	81	2018-01-30	2018-05-22
ACT Reading Test 3 - Edition 1	5	2017-08-28	2017-09-28
ACT Reading Test 3 - Edition 2	3	2017-11-22	2018-01-26
ACT Reading Test 3 - Edition 3	38	2018-02-08	2018-06-16
ACT Science Test 1 - Edition 1	696	2017-08-18	2018-02-07
ACT Science Test 1 - Edition 2	55	2017-08-28	2018-03-15
ACT Science Test 1 - Edition 3	11	2018-01-29	2018-02-13

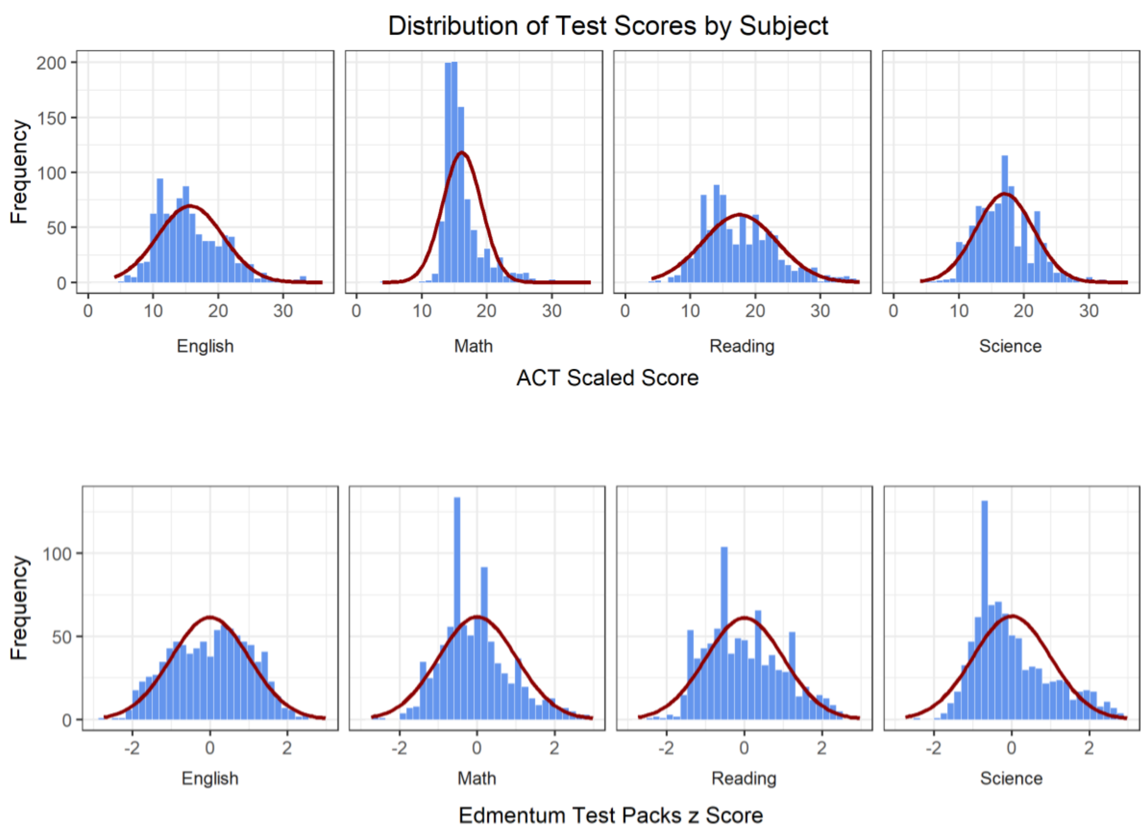
Assessment Title	N	Earliest Date	Latest Date
ACT Science Test 2 - Edition 1	95	2017-08-29	2018-03-01
ACT Science Test 2 - Edition 2	687	2018-01-08	2018-04-17
ACT Science Test 2 - Edition 3	87	2018-01-29	2018-05-22
ACT Science Test 3 - Edition 1	6	2017-08-28	2017-11-22
ACT Science Test 3 - Edition 2	3	2018-01-22	2018-05-16
ACT Science Test 3 - Edition 3	50	2018-02-13	2018-06-11

Appendix B. Test for Normal Distribution of Scores

Subject	Test	Shapiro-Wilk *W*	*p* Value
English	ACT Scaled Score	0.955***	0.000
	Edmentum Test Packs *z* Score	0.987***	0.000
Math	ACT Scaled Score	0.821***	0.000
	Edmentum Test Packs *z* Score	0.947***	0.000
Reading	ACT Scaled Score	0.961***	0.000
	Edmentum Test Packs *z* Score	0.976***	0.000
Science	ACT Scaled Score	0.976***	0.000
	Edmentum Test Packs *z* Score	0.949***	0.000

***Statistically significant at the .001 level

Appendix C. Distribution of Test Scores by Subject, ACT and Test Packs Assessments



Appendix D. Scatterplots Showing Relationship between Test Packs Assessments (Form 2) and ACT Scores