tl;dr

Written English Is Becoming More Readable, Why Is Reading Comprehension Falling?

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Abstract

Written English is becoming more readable. Words and sentences are getting shorter, resulting in a language that is easier to understand by a greater audience. Conversely, reading comprehension scores are dropping with today's students. If written English as a whole is becoming easier to understand, why is there an increasing issue with reading comprehension?

In many ways this study follows the arc of early readability pioneer Rudolf Flesch, a lawyer who fled Austria to avoid Nazi capture. Settling in the United States, he began a career in linguistics with his PhD. dissertation "Marks of a Readable Style", which outlines a formula for measuring readability. This formula has evolved into one of the most famous and lasting measures in computational linguistics, *Reading Ease*. The implications of *Reading Ease* have had profound effects on the stylistic evolution of written English, beginning with journalism and continuing to impact how we communicate today. Flesch's work evolved from computational to psychological as the author of over a dozen books promoting the educational benefits of using plain English to further understanding.

I begin with the history of readability and its impact on written English. I explore reasons behind a decline in student reading comprehension including the impact of digital media. I conclude with proposals on how to improve student reading comprehension.

Introduction

This study looks at the history of applying statistical analysis to written English and observations about a general trend towards shorter words and sentences in written English. These early statistical methods evolved into structured formulas to measure readability, or the ease of understanding text due to writing style. These readability measures were initially developed by academic researchers but gained further recognition through government studies to encourage literacy. Newspaper publishers introduced applications of readability to mainstream audiences after learning readable writing increases newspaper readership. This profit-driven motivation led to a series of publisher initiatives to encourage authors to write articles with broad appeal by using a readable writing style.

Due to the success of readable writing in newspapers, a widespread interest in readability formulas followed. New formulas were developed which utilize different approaches on how to measure readability. A selection of differences between popular formulas are explored.

As the methods to measure readability increase, so have the number of studies measuring readability. This paper looks at the appropriate considerations to follow when selecting a source to analyze with readability measures. I illustrate how readability has changed by sharing findings from an original analysis on lead paragraphs from the New York Times between 1932 and 2016. This finding is supported by results from numerous other academic studies observing changes in readability measures.

The readability trend has also been observed in high school English curriculums. Current reading curricula favor modern books that tend to be more readable when compared with older books. This observation is proven through a comparison of readability scores for books listed on a 1922 reading curriculum and a curriculum from 2020. Academic research has observed a similar trend in high school curricula studies.

The primary objective of readability is to improve the reader's ability to understand text. This ability, known as reading comprehension, has been declining on national assessments of United States high school students since the 1970’s. I investigate how a decline in student recreational reading may be a possible cause behind the drop in reading comprehension scores. I introduce a correlation between reading comprehension scores and the variety of text media that a student reads from. This study indicates a benefit to reading books as the strongest students include longform books in their written media variety.

To further illustrate the benefits of reading books I provide an overview of the psychological process of reading. Reading consists of two components, decoding, the translation of written text, and comprehension, the understanding of text. I describe the mechanics behind each and share how reading comprehension has been historically described through various models. The current accepted model type for explaining reading comprehension, interactive, leverages aspects of earlier comprehension models. A detailed breakdown of an interactive model is provided through a description of the construction-integration model. The construction-

integration model emphasizes the benefits of previous knowledge during the comprehension process, a finding that is supported by multiple studies indicating this benefit.

As a final exploration into a possible contributor to declining reading comprehension scores I detail a growing concern amongst education scholars about the impacts of reading on digital media. Usability studies indicate a “shallow” skim reading style when reading online, an effective approach when checking email or reading social media to find and extract information as quickly as possible. This differs from the linear reading style necessary for traditional media necessary to comprehend text in long formats like books. A versatile reading approach is proposed in order to most effectively navigate all types of text.

To conclude, I highlight the areas requiring the most focus in today’s education system. Possible solutions are proposed to America’s educators for improving reading comprehension through activities that go beyond teaching students how to read.

Readability

History of Computational Linguistics

Readability of a text is defined by psychologist George Klare as “the ease of understanding or comprehension due to the style of writing.” (DuBay, 3). Modern readability studies that leverage statistical analysis can be traced back to the 1880’s when English professor Lucius Adelno (L.A.) Sherman began counting average sentence length per 100 periods. In his book (1893), *Analytics of Literature, A Manual for the Objective Study of English Prose and Poetry*, he showed how senten celength averages shortened over time:

- **Pre-Elizabethan times**: 50 words per sentence
- **Elizabethan times**: 45 words per sentence
- **Victorian times**: 29 words per sentence
- **Sherman’s time**: 23 words per sentence.
  (DuBay, 10)

In addition to sentence length, Sherman also observed that sentences were becoming simpler. He credited this to the influence of spoken English on written English where he writes:

> “Literary English, in short, will follow the forms of the standard spoken English from which it comes. No man should talk worse than he writes, no man writes better than he should talk…. The oral sentence is clearest because it is the product of millions of daily efforts to be clear and strong. It represents the work of the race for thousands of years in perfecting an effective instrument of communication.” (Sherman, 312)

Sherman’s work introduced a new objectivity into literary criticism by establishing that literature is a subject for statistical analysis (DuBay, 10). In the 1920’s, this statistical approach was furthered with the publishing of “A Method for Measuring the ‘Vocabulary Burden’ of Textbooks” by Bertha Lively and Sidney Pressey. Lively and Pressey observed that teachers spent a significant amount of class time teaching technical vocabulary. They introduced methods for measuring the vocabulary load of text books by comparing words in a textbook to the *The Teacher’s Word Book*, an alphabetical list of 10,000 words most likely to occur in children’s English literature (Thorndike, iii). The objective of the study was to reduce the “vocabulary burden” of textbooks. This approach introduced the effectiveness of a statistical approach for predicting text difficulty (Dubay, 6).

In 1925, the American Library Association (ALA), the oldest and largest library association in the world, issued a bulletin on the “Developing Interest in Adult Education” declaring “...an increased interest in the education of adults.” (American Library Association, 167). To address this growing interest in the education of adults the ALA implemented a Sub-Committee on Readable Books which published its findings in a ten year report in 1934 “: ". . . readers' advisers have found their accomplishments seriously limited because there was so little published material that meets the need (of people with limited reading experience). We are

convinced that any further attempt to ferret out and list pseudo-readable books from among existing publications will be largely profitless, and our efforts now must be to convince writers and publishers of the need…" (Stevenson, 227).

Early Readability Formulas

In 1943 the chairman of The Subcommittee on Readable Books, Rudolf Flesch, published his Ph.D. titled the "Marks of a Readable Style". His dissertation introduced an early version of the Reading Ease formula which will become one of the most widely used formulas for measuring readability.

$$206.835 - 1.015\left(\frac{\text{total words}}{\text{total sentences}}\right) - 84.6\left(\frac{\text{total syllables}}{\text{total words}}\right)$$

(Flesch)

The Reading Ease formula published in 1948 measures reading difficulty by taking in the total number of words, sentences, and syllables from a piece of writing. After applying additional mathematical standardization, the Reading Ease formula returns a number between 0 and 100. The numerical result represents the writing difficulty where numbers are more difficult to read and higher numbers are easier to read. Rudolf Flesch illustrates an example of this in practice:

Passage	"John Loves Mary."	"John has a profound affection for Mary."	"Even though John is not normally given to a display of his deeper emotions, he allegedly has developed a profound affection for Mary, as compared to the more equable feelings he seems to have for Lucy, Fran and, to a lesser extent, Sue."
Reading Ease Score	**92** Very Easy	**67** Plain English	**32** Difficult

Adapted from examples in How to Write Plain English: A Book for Lawyers and Consumers
(Flesch, 1979)

Impact on Journalism

Flesch's work was noticed by the Associated Press (A.P.) which hired him to become a consultant tasked with making their newswires more readable. The effect was profound with Time magazine observing "The A.P. took its medicine like a man. In effect, it ordered all hands to learn to say it simply or get out." ("The Press: Say it Simply", 1). It is estimated that by making the articles more readable, publishers could increase readership by forty to sixty percent (DuBay, 20).

In 1947, agricultural newspaper Wallace's Farmer, used a split-run edition to measure the effects of readability. An article written at the 9th-grade level was printed on one run and at the 6th-grade level on the other run. They found that increasing readability increased readership up of the article 18 percent. In a second test, they took great care not to change anything except readability, keeping headlines, illustrations, subject matter and the position the same. He found readership increases of 45% for an article on nylon and 60% for an article on corn (DuBay, 30).

Other studies found that reader engagement improved when articles are written in a more readable style. In 1947, interviews were conducted with over 1,000 newspaper readers where they were asked how much of the news content they read; if they did not finish the story, when did they stop; and what made them stop. This study showed that a more readable style contributes to the readers' tendency to keep reading the text (DuBay 31).

New Readability Measures

Flesch's Reading Ease formula has become one of the most widely used and one of the most tested and reliable (DuBay 21). In 1976, the Reading Ease formula was revised with new weightings that produce a score equivalent to a reading grade-level determined through studies with the United States Navy. These studies were conducted in two parts, the first determined the reading level of 531 Navy personnel and the second tested their comprehension of passages from Navy training materials. The comprehension tests showed "the highest percentage of errors in both the readers with the lowest reading grade levels and in the modules with the highest grade-levels of readability… the study confirms that learning time as well as reading ability are significant performance measures for predicting readability." (DuBay, 92)

In addition to Flesch's formulas, over 200 other formulas have been developed to measure readability. However only a handful of these formulas are reliable to determine the reading level of a text (Readability Formulas). A comparison between the approaches of a selection of reliable readability formulas is shown below. Each formula relies on some combination of counting words, sentences and syllables to determine text reading level.

Readability Formula	No. words	No. sentences	No. syllables
Flesch Readability Ease	✓	✓	✓
Flesch-Kincaid Grade Level	✓	✓	✓
SMOG (McLaughlin, 1969)			✓ 3 or more syllable words in 30 sentences
FORECAST (Sticht, 1975)			✓ single syllable words per 150 words
Fry's Graph (Fry, 1968)		✓ in 100 words (3 samples)	Av syllables per 100 words (3 samples)
Gunning fog index (Gunning, 1968)		Av sentence length per 100 words	✓ no. syllables in 100 words

Note: the ticks indicate the criteria used within the formula

(Beaglehole and Yates, 59)

Measuring Changes to Readability Over Time

Register Selection

Using readability formulas and other methods, changes to the English language have been studied by linguistic scholars. Modern availability of text-based corpora, large and structured sets of text, and accessible processing techniques through programming languages have led to numerous studies of linguistic variation and change in English (Biber and Gray, 105). Within *Being Specific about Historical Change: The Influence of Sub-Register*, Douglas Biber and Bethany Gray discuss numerous considerations when choosing a text-based corpus for review. Most importantly, the authors emphasize careful consideration on analyzing a consistent register, or language used for a specific purpose. Not controlling for a consistent register can "lead to inaccurate conclusions; in fact, even minor register differences can sometimes confound historical comparisons." (Biber and Gray, 108).

One challenge with ensuring register consistency is the "limited availability of historical corpora that are both large and sampled carefully with detailed register information" (Biber and Gray, 108). Biber and Gray argue that "News writing and academic prose are especially interesting registers with respect to the historical trends of colloquialization and compression. News writing is interesting because it has been influenced by both historical trends, becoming both more colloquial and more compressed." (Biber and Gray, 107).

Analyzing Readability in The New York Times

To measure readability changes over time, this analysis will apply the Flesch Reading Ease Score to the lead paragraphs of the New York Times between 1932 and 2016.

The New York Times was founded in 1851 and has gone onto become one of the largest Newspapers in the world, currently 18th in the world by circulation (Cision Media Research) and one of the most well regarded through its designation as a newspaper of record (The Editors of Encyclopaedia Britannica). The New York Times has also made its archive of past articles available digitally through an Application Programming Interface (API) which allows users to programmatically access New York Times data for independent uses.

The New York Times has been chosen for analysis because of its data availability, consistency of register, and editorial recognition.

Data

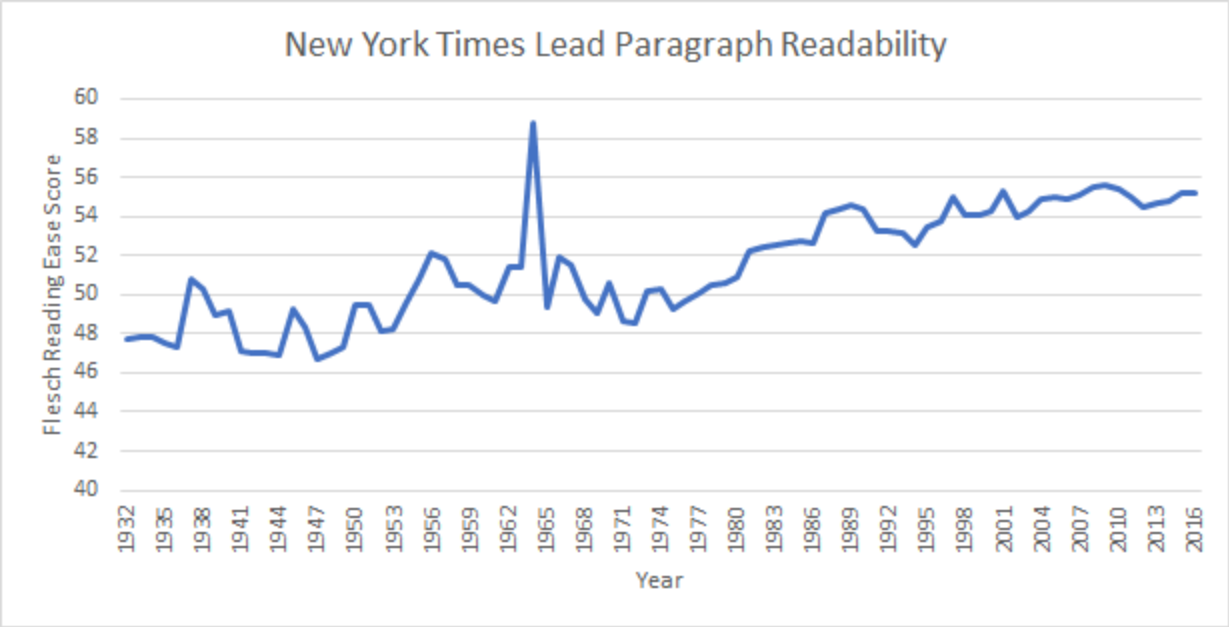
The lead paragraph data was originally sourced from the New York Times API and downloaded through a file published on Kaggle, an online community for sharing datasets and analysis. Lead paragraphs were grouped by year and the Flesch Reading Ease Score was applied to each group using the textstat Python readability library. The Flesch Reading Ease formula was used due to its simplicity and appropriateness for all kinds of texts (Readability Formulas) and has been found to be the most convenient for newspaper copy (DuBay, 71).

Process

This analysis[1] aggregate the values of an average 80,000 articles per year. Within this 80,000 article population there are significant variations between individual lead paragraph scores. Research has been conducted that illustrates “the language of news varies according to topic” (Ilias Flaounas, Omar Ali, Thomas Lansdall-Welfare, Tijl De Bie, Nick Mosdell, Justin Lewis & Nello Cristianini) even within a single newspaper. To fully understand readability trends within the New York Times, it would be necessary to perform this analysis by individual topic sections.

Throughout the eighty year period being considered in this analysis, The New York Times article output has varied from as few as 64,000 articles to consistently over 100,000 articles per year between 2006 and 2011. To account for this difference in sample size between years, a Bayesian average was applied that builds on the traditional average calculation to ensure comparisons could be made across years.

[1] Full details on this analysis are available within the repository here: https://github.com/justinkraus/thesis.



Shown here is the result of this analysis illustrating The New York Times lead paragraph readability has increased from a score of 47 (difficult to read) in 1932 to 55 in 2016 (fairly difficult to read). While this isn't a numerically significant change, it does indicate an overall trend to a more readable style that is consistent with the influence of Rudolf Flesch's Reading Ease formula on the newspaper industry.

Other Readability Studies

The table below is a selection of independent studies conducted on text registers to determine how the registers readability has changed. Results are shown with Gunning Fog scores, another popular readability measure with scores that corresponds to grade level. On the Gunning Fog index lower scores correspond to a lower grade-level which indicates higher readability.

Not all of the scores shown here were originally produced with the Gunning Fog calculation. In these instances the equivalent grade-level was taken from the readability measure used in the original calculation. For example, if the original calculation produced a "College Senior" level of material this would be mapped to the Gunning Fog "College Senior" score 16. A study in the *IEEE Transactions on Professional Communication* found no "strong preference for using any particular reading equation" (SHIXIANG ZHOU, HEEJIN JEONG, AND PAUL A. GREEN 109) when compared on the measures of consistency between popular formulas, supporting the ability to consider findings from different formulas.

Although the formulas used to calculate readability are different across some registers, the results are provided to illustrate that these registers have changed, becoming more readable over time.

Readability Over Time

Group	Source	Historic	Current
Newspapers	Newswires	16	11
	Newspapers	12	9
	The Wall Street Journal	14	11
Other Sources	The New York Times Best Seller List	8	6
	Standard Auto Insurance Policy	17	9

Additional studies have been conducted to study register readability levels as-of a point in time. The results of these are provided with Flesch Reading Ease Scores where higher scores indicate more readable materials. This table as well as the table above with supporting sources are provided within Appendix A.

Changes to High School English Reading List

High school reading lists have traditionally relied on classic literature but over time reading lists have increasingly featured modern works from the 20th century. The primary inspiration behind this change is to increase student engagement, or to allow students to “feel connection to the literature.” as said by Arizona State University English professor Alleen Nilsen. In 1963, only one of the nine most commonly taught books in public high schools was written in the 20th century. By 1988, the 10 most commonly taught novels in public schools included four books from the 20th century (Brittain).

Based on this trend towards inclusion of modern writing in high school english curricula, I set out to determine if assigned modern novels are increasing in readability compared with historically assigned novels. This comparison is performed using readability scores of books on the 1922 required high school reading curriculum for The Texas State Department of Education (TSDoE) with a list from the Texas Midland Independent School District’s (Midland ISD) 2020/2021 approved books for high school English literature.

Data

The United States does not have a nationally mandated reading list. Decisions around high school reading are determined by individual school districts. Districts decide their reading list by

providing an approved list of books that district teachers must choose from or granting teachers the autonomy to choose their own (Eldeib). Midland ISD follows the former approach by providing teachers with an annually reviewed district approved list which they select from. Midland ISD is a public school district in Midland Texas that contains two 6A high schools, the largest size in the Texas school rating system, that were rated as “academically acceptable” by the Texas Education Agency in 2015 (Texas Education Agency). While the current Midland ISD list differs in scope from the 1922 TSDoE state-level list, both the size and acceptable education rating provide credibility that Midland ISD can be used as a representative sample of current high school reading selections.

Process

For curriculum comparison the lexile measures for each book will be used. The lexile framework was developed by MetaMetrics, funded originally by the National Institute of Child Health and Human Development. It is a popular method used by schools to measure a student reader’s ability and serves two unique functions: a measure of how difficult a text is or a student’s reading ability level (Scholastic). The lexile measurement is calculated by computing the average sentence length and average word frequency found in the American Heritage Intermediate Corpus (DuBay, 52), a corpus prepared with the aim of assessing the vocabulary of Grades 3-9 (Paikeday, 281). Higher scores indicate a more difficult reading level.

Lexile scores for the 1922 TSDoE were sourced from online sources including publisher provided references and Amazon product information. The Midland ISD scores were provided directly on the reading list themselves. Full details of the sources and underlying scores contained as part of the average are included in Appendix B.

Reading List Lexile Score Comparison Overview

1922 Texas State Department Reading List		**2020-2021 Midland ISD Reading List**	
9th Grade Reading List Average Lexile Score	1253	English I Reading List Average Lexile Score	866
10th Grade Reading List Average Lexile Score	1194	English II Reading List Average Lexile Score	822
11th Grade Suggested Outside Reading List Average Lexile Score	1060		

It is clear when looking at the average lexile scores that the TSDoE reading list has higher lexile averages across all grade levels, indicating the selected titles are more challenging and less readable. While the curriculum sample sizes are different, the range of scores does not have a high variability and the average is representative of the overall scores.

Common Core, a non-profit group founded by former senior educators with the objective of standardized reading curricula across the United States, references similar changes in reading

curricula. One study found “precipitous declines” in the average sentence length and vocabulary level of textbooks for a variety of grades between 1963 and 1991 . Another study found a 350 point gap between the difficulty of end-of-high school and college texts— equivalent to 1.5 standard deviations and more than the lexile difference between suggested grade 4 and grade 8 texts (Common Core). This finding suggests that graduating high school seniors are inadequately prepared for the difficulty of text in college or beyond.

Reading Comprehension

With text becoming easier to read for all sources, including student materials, it might be assumed that high school reading comprehension would be at an all time high. However this does not appear to be the case.

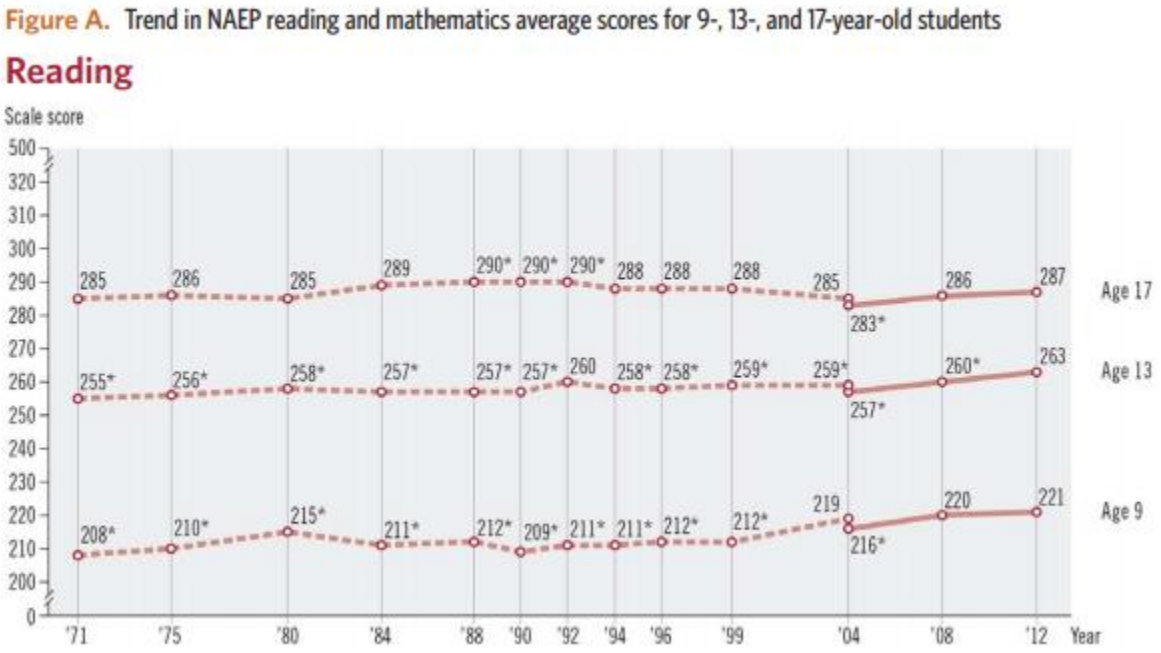
Measuring Reading Comprehension

Within the United States, reading comprehension is tested nationally every few years by the National Assessment of Educational Progress (NAEP). This assessment, known as the Nation’s Report Card, is considered the gold standard measure of learning nationwide (“Reading Scores on National Exam Decline in Half the States”). The NAEP measures reading comprehension by asking students to read selected grade-appropriate materials and answer questions based on what they have read (National Assessment of Educational Progress). Assessment scores are bucketed into achievement levels based on ability to illustrate certain concepts related to reading, shown here are the achievement level descriptions for 12th grade students.

> **Basic**
> Should be able to identify elements of meaning and form and relate them to the overall meaning of the text. They should be able to make inferences, develop interpretations, make connections between texts, and draw conclusions; and they should be able to provide some support for each. They should be able to interpret the meaning of a word as it is used in the text.
>
> **Proficient**
> Should be able to locate and integrate information using sophisticated analyses of the meaning and form of the text. These students should be able to provide specific text support for inferences, interpretative statements, and comparisons within and across texts.
>
> **Advanced**
> Should be able to analyze both the meaning and the form of the text and provide complete, explicit, and precise text support for their analyses with specific examples. They should be able to read across multiple texts for a variety of purposes, analyzing and evaluating them individually and as a set.
>
> (National Assessment of Educational Progress)

These achievement levels are cumulative, meaning a student that scores within the advanced range also illustrates basic and proficient abilities.

In 2012, the NAEP released a large-scale report titled *Trends in Academic Progress* meant to provide a deep exploration of reading comprehension in the United States. This report includes assessment results going back until 1971, which are shown here for all tested age groups:



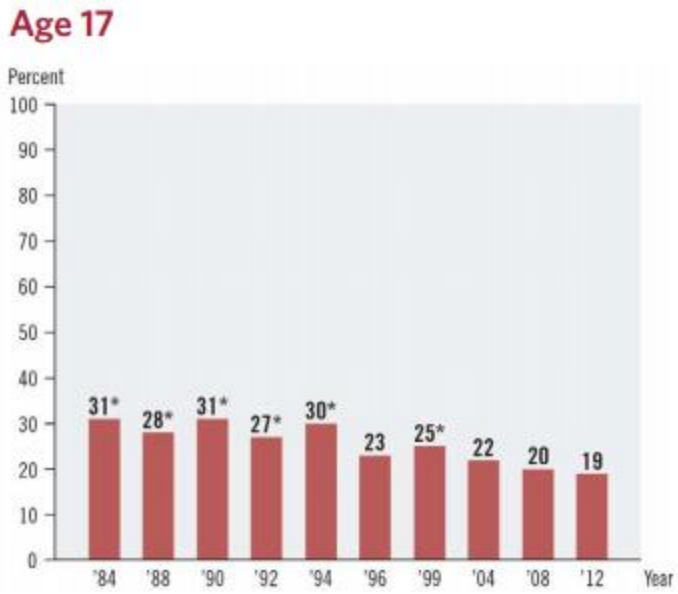
(National Assessment of Educational Progress)

Since the 2012 report scores for 17-year-old students have fallen to 285 in 2019. The 17-year old age-group will be the continued focus group for this study due to their advanced reading abilities relative to the younger groups with material that could be more impacted by readability.

There are too many variables at play to provide a direct answer as to why scores haven't improved at the national level. Researchers warn that isolating specific factors like funding is not appropriate (Barnum). However studies have found that certain indicators correlate to higher reading comprehension scores which could point to changing behavioral trends with high school students.

Decline of Recreational Reading

As part of the *Trends in Academic Progress* report in 2012, the NAEP provided student survey results to indicate possible indicators tied to reading comprehension performance. The NAEP has found that students who read for fun score higher on the assessment (National Assessment of Educational Progress)



(National Assessment of Educational Progress)

The survey found that reading for fun has been declining for 17-year-old students since 1984. This finding is consistent with all age brackets, the Bureau of Labor Statistics found that Americans who read for fun has fallen by more than 30 percent since 2004. Aggregate reading time for Americans has fallen from an average of 23 minutes per day in 2004 to 17 minutes per day in 2017 (Ingraham).

The change in behavior is the result of competition for recreational attention. A long term study in The Netherlands between 1955 and 1995 found that “Competition from television turned out to be the most evident cause in reading”. The National Assessment for the Arts has observed a decrease in reading from the 1980’s (Ingraham), consistent with the NAEP study for High School students.

While television is an early culprit, the competition for recreational attention has also increased with the advent of digital devices. Recent studies have shown that reading for fun sharply decreases after age eight. In a study of 2500 families conducted by Scholastic in 2015, the top reason given for why students don’t read for fun more was “so many other things that I now enjoy more than reading” (Flood).

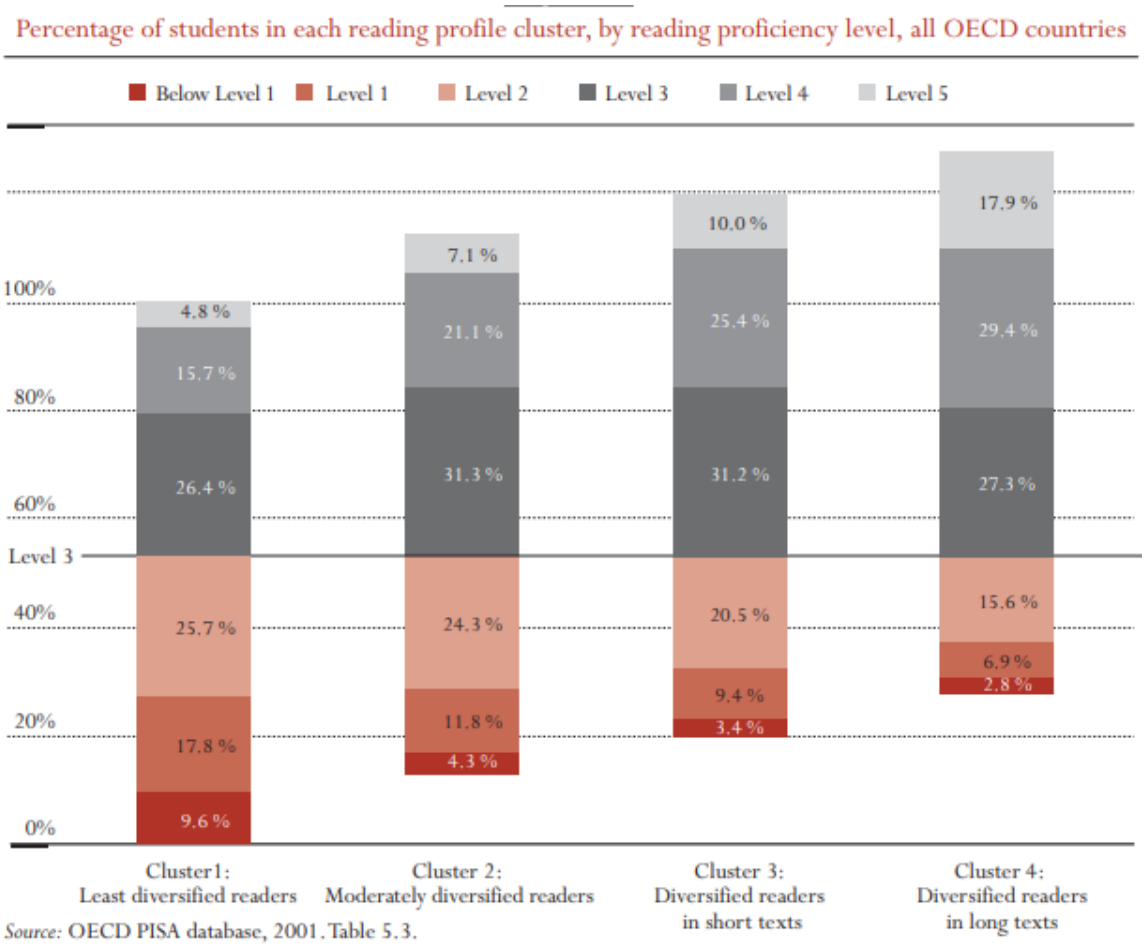
There is not conclusive research to confirm why reading for fun correlates with higher test scores but a study by the Renaissance Learning group suggests that reading enables students to practice reading and expands their vocabulary. More than half the variance in students reading comprehension scores can be explained by the depth and breadth of their vocabulary knowledge (Renaissance).

Diversity of Text Media

In 2000, a worldwide study by the Organization for Economic Co-operation and Development looked at the reading habits of 174,000 students across 32 countries. A component of the study, Programme for International Student Assessment (PISA), profiled readers based on the diversity of text-media the students read from and placed them into one of four categories based on this diversity:

> **Least diversified**, only frequently read magazines.
>
> **Moderately diversified**, frequently read magazines and newspapers.
>
> **Diversified in short texts**, frequently read magazines, newspapers, and comics.
>
> **Diversified in long texts**, frequently read magazines, newspapers and books.
>
> (Programme for International Student Assessment)

PISA found that as diversity of media increases so does reading proficiency. The chart below details reading categories as well as the proficiency levels within each category.



Source: OECD PISA database, 2001. Table 5.3.

As shown in cluster 4 of the chart, the most proficient readers are diversified in their media variety and include some regular reading of books. The number of books read per year has also been an area of decline, a survey from Pew Research found that the share of adults not reading any book in a given year tripled between 1978 and 2014 (Ingraham). In the biannual *Scholastic Kids and Family Reading Report*, the number of American children who "like reading books for fun" fell 10% between 2010 and 2015 (Flood). This implies greater implications on the overall decline in recreational reading due to the strong connection books have to reading proficiency.

The PISA study does not provide conclusive reasons as to why diversified readers lead to improved reading proficiency. As part of the study PISA indicates that "daily engagement" of reading in diverse media can be a fruitful way of becoming a proficient reader. Common Core has also found that text-complexity is another indicator of how well students will perform on a reading assessment "what chiefly distinguished the performance of those students who had earned the benchmark score or better from those who had not was not their relative ability in making inferences while reading or answering questions related to particular cognitive processes, such as determining main ideas or determining the meaning of words and phrases in context. Instead, the clearest differentiator was students' ability to answer questions associated with complex texts." (Common Core). Common Core advocates for increasing complexity through curricula that focus on difficult to read materials. This generally supports the PISA findings that indicate students who read books will do the best on a reading comprehension assessment. PISA also determined that students who have more books in their home perform better on reading comprehension assessments (Programme for International Student Assessment, 131).

There is not a definitive reason for why reading books leads to better reading comprehension scores but it is suggested books build stronger and deeper general knowledge due to fully exploring a topic more extensively for richer understanding. Books may "also grow a student's reading stamina, i.e., their ability to focus on independent reading for longer periods of time without being distracted or disengaged from the task." (Renaissance). Another article emphasizes the importance of reading complex text to "capture the nuance, subtlety, depth, or breadth of ideas" (Common Core). These suggestions are best illustrated by observing the mechanics of reading comprehension and the focus required to engage in deep reading.

Reading Comprehension Process

Reading consists of two parts: decoding, where the connections between sounds and letters are represented, and comprehension, the process of constructing meaning from text (Lenz). There have been numerous models developed which describe the reading comprehension process. The models differ in their descriptive approaches but share common components that are needed to complete the reading comprehension process.

Components of Reading Comprehension

1. **Phonology** is the first process that deals with the association of sounds with letters
2. **Syntax,** the way in which words are put together to form phrases.
3. **Working memory**, an individual's ability to hold information in the short term memory.
4. **Semantic**, understanding of meaning.
5. **Orthography,** the understanding of writing rules and knowledge of spelling.

(Babashamsi et al. 150)

These components have been classified and arranged into four various categories of reading comprehension models which connect these components.

Categories of Reading Comprehension Models

1. **Psycholinguistic Model**, continuous process of testing the reading text. The reader strives to predict, to sample and to confirm or to change previous predictions, and consequently tests and samples the text again.

2. **The Bottom-up Model,** begins from vocabulary to the sentence level. The reader recognizes every letter, organizes the perceived letter into words, and finally classifies the words into phrases, clauses, and sentences. Meaning at any level is accessed only once, and processing at previous levels is always completed.

3. **The Top-down Model,** a selective process that involves partial use of available minimal language cues selected from perceptual input on the basis of the reader's expectation. Therefore, in the process of reading, the reader chooses from the available information to select and predict a decodable language structure and it cannot be attributed to a perceptual process.

4. **The Interactive Model,** refers to reading as an 'interactive' process between a reader and a text and emphasizes reading fluency. The reader interacts with the text in order to extend the meaning, and the reader uses different types of knowledge such as linguistic or universal knowledge (through bottom-up processing) as well as schematic knowledge (through top-down processing).

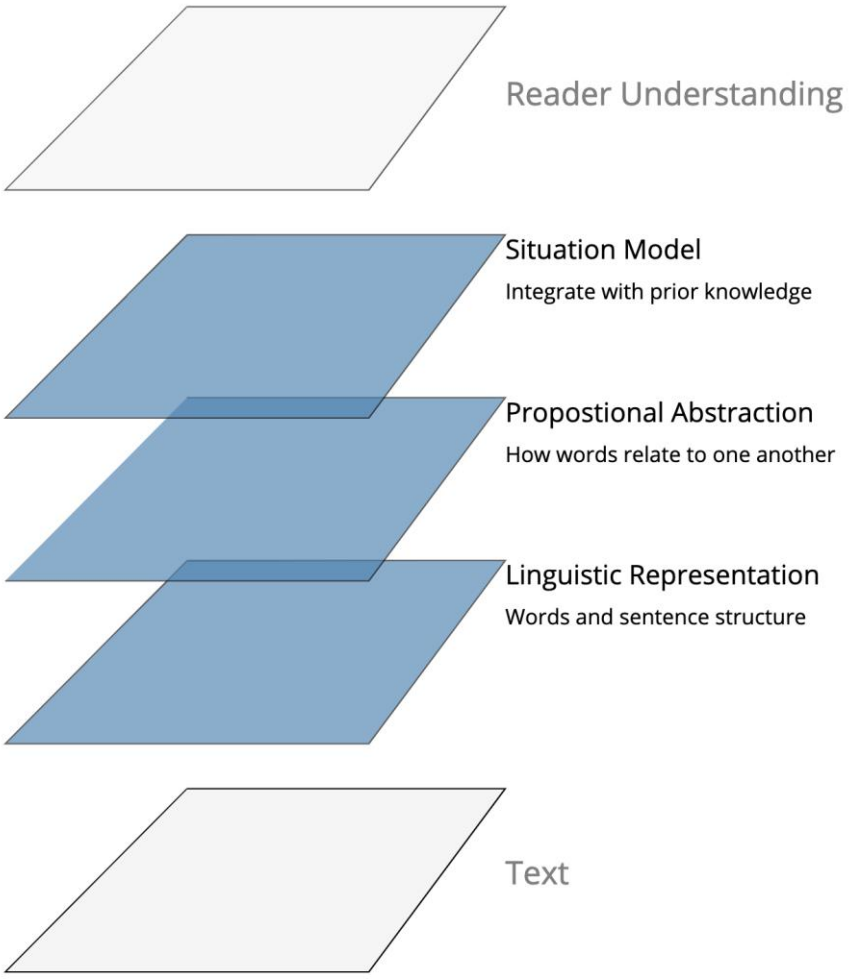
   (Babashamsi et al. 150-151)

Historically researchers viewed reading comprehension through the bottom-up model. The top-down approach was introduced later as an alternative to how meaning is accessed. Neither the bottom-up nor the top-down model of reading is sufficient for what happens during the process of reading. The interactive model combines elements of the bottom-up and top-down models which happen in parallel (Babashamsi et al. 151-152). The interactive models have become a popular view as they sufficiently describe the entire comprehension process.

Construction-Integration Model

The construction-integration (CI) model is an interactive model for reading comprehension. The CI model doesn't specifically address foundational reading skills like phonology, but assumes proficient decoding of words, so that it can focus attention on the process of comprehension itself (Shanahan).

Construction-Integration Model



Within the CI model there are three levels of comprehension that occur in two parallel phases.

Construction Phase

Linguistic Representation
Processing of the text's words and phrases.

Propositional Abstraction
Determining the meaning of the text by combining words and phrases into idea units, also known as semantic analysis.

Integration Phase

Situation Model
Mental model of the text is constructed linking ideas described in the text with previous knowledge.

(Snowling and Hulme 210-211)

Within the situation model, the information portrayed by the text can be much greater than what is written on the page. A reader who does not retrieve additional information from previous knowledge to integrate with the new information provided by the text does not really understand the text even if he or she has formed meaning correctly during the construction phase (Snowling and Hulme 212).

Part of this is due to how writers write, they leave out information that they assume readers will know. If authors put all the information in, their writing would be tedious. But if readers don't have the necessary previous knowledge to fill in what is missing then they have a hard time making sense of the text (Wexler). In the example "I promised not to play with it, but Mom still wouldn't let me bring my Rubik's Cube to the library." The author has omitted three facts vital to comprehension: you must be quiet in a library; Rubik's Cubes make noise; kids don't resist tempting toys very well. If you don't know these facts, you might understand the literal meaning of the sentence, but you'll miss why Mom forbade the toy in the library (Willingham).

Benefits of Previous Knowledge

Working memory is what enables a person's brain to process and retrieve information simultaneously while reading. In older adults, age-related decrements in working memory limit the ability to process text, especially if the text is complex which requires additional working memory to infer meaning. One study found that accumulated knowledge helps with information processing as meaning is recognized quicker and less working memory is needed. Readers with high accumulated knowledge illustrated improved reading comprehension as the readers can integrate the text with their existing knowledge to construct a coherent representation. Low-knowledge readers needed to make inferences which require additional working memory to retrieve information from long-term memory (Liu et al.).

Another study focused on the impacts of existing knowledge with children. Researchers provided elementary school students with a story narrating half an inning of a baseball game. Each student would read the story and reenact the described actions on a small-scale model of a baseball field. The study found that reading ability had little impact on how well the story was understood but knowledge of baseball had a strong impact on understanding. Weaker readers did as well as strong readers if they had previous knowledge of baseball (Core Knowledge Foundation).

These studies confirm the importance of strong, previously learned, background knowledge in order to fully understand the meaning of text while reading.

Deep Versus Shallow Reading

At Stanford University, Assistant Professor Dr. Julian Hermida shared an observation with colleagues that “It is a recurring complaint among faculty that students do not complete their assigned readings or that they read them superficially.” (Hermida). The cause of this is due to a surface level reading approach by students which “does not promote understanding or long-term retention of knowledge.” (Hermida). This is contrasted with a deep reading approach where “the reader uses higher-order cognitive skills … to negotiate meanings with the author and to construct new meaning from the text.” (Hermida).

Hermida’s observation has been shared by other scholars, perhaps the most well known example is by author David Carr in his book “The Shallows: What The Internet Is Doing To Our Brains”. Carr’s inspiration for this book came from an observation with his own ability to concentrate. "I'd sit down with a book, or a long article, and after a couple of pages my brain wanted to do what it does when I'm online: check email, click on links, do some Googling, hop from page to page." Carr argues that this practice stays with us even after we are no longer online “The more time we spend surfing, and skimming, and scanning ... the more adept we become at that mode of thinking." (All Things Considered).

Reading Online

Carr’s observation about online reading is supported by findings from the user experience research firm Nielsen Norman Group (NNG). In one study NNG utilized eye-tracking equipment to follow how 300 participants gazed when reading on a screen. The study found that people primarily scan when reading on a screen, leaving some text unread. Even when users do scan content in its entirety they never scan in a perfectly linear way, instead jumping around and skipping content (Nielsen Norman Group).

The scanning approach results in a variety of reading patterns, one of the most common is the “F-pattern” where users focus primarily on the upper part of the content area, moving down the page to cover less and less content in the process. The resulting heatmap was produced using a participants eye-tracking pattern.

(Nielsen Norman Group)

This scanning pattern is useful when performing the example tasks that Carr references, like checking email or browsing search results for an answer, but it does not replace the linear reading pattern necessary for deep reading of text. Deep reading processes that are missing from this pattern include connecting background knowledge to new information, expanding into the perspectives of others and integrating everything into critical analysis. In other words, when we skim we “don’t have time to think” (Wolf).

As screen reading continues to rise, researcher Maryanne Wolf argues there is a growing tendency towards the superficial gathering of information. To counter the effects of digital skim reading, Wolf encourages a “biliterate brain” which is equally capable of shallow and deep reading (Wolf). In order to develop this capability it is necessary to read from print books.

Conclusion

As we've observed there is a growing issue with reading comprehension related to behavioral changes with today's students. These changes stem from the impact of digital devices which have affected how students spend their time as well as the ways in which students interact with traditional forms of text-based media. The benefits of increased accessibility for modern English readers, through a language that is easier to comprehend with a proliferation of available reading material, is not enough to counter the negative behavioral changes from digital media.

Reading comprehension scores have been declining most rapidly for students with low-income backgrounds and parents with less education. These students don't have access to the same levels of supplementary learning as affluent students, resulting in a smaller general knowledge base necessary for comprehension (Wexler). As a result, greater responsibility falls on the education system to improve the learning experience for these students. Reading lists need to be tailored to maximize student reading engagement while also preparing students for subject matter that will be encountered on reading comprehension tests. Tailored curricula was the approach taken by Massachusetts in the 1990's which has caused the state to become one of the best for reading comprehension (Willingham). Washington D.C., the fastest-improving of the 27 urban school systems within the United States, credits their improvements to teaching through shared experiences like field trips and activity based learning (Green and Goldstein).

These approaches indicate a need for learning that goes beyond the skill of reading and emphasizes the accumulation of knowledge. The benefits of accumulated knowledge have positive impacts on the comprehension process, ideally motivating students to pursue independent learning activities. Books have proven the best media for learning, with a strong correlation to reading proficiency.

Appendix

A. Readability Scores

Readability Over Time

Group	Source	Historic	Current	Study Reference
Newspapers	Newswires	16	11	https://cognella-titles-sneakpreviews.s3-us-west-2.amazonaws.com/81133-1A-URT/Wilson_SP_updated.pdf
	Newspapers	12	9	https://cognella-titles-sneakpreviews.s3-us-west-2.amazonaws.com/81133-1A-URT/Wilson_SP_updated.pdf
	The Wall Street Journal	14	11	https://www.wyliecomm.com/2016/04/the-gunning-fog-index/
Other Sources	The New York Times Best Seller List	8	6	https://www.rd.com/article/have-bestsellers-become-dumber/
	Standard Auto Insurance Policy	17	9	http://pages.stern.nyu.edu/~wstarbuc/Writing/Flesch.htm https://law.onecle.com/florida/title-xxxvii/627.4145.html

Point-in Time Readability

Source	Flesch-Kincaid Readability Score		Study Reference
Green Eggs and Ham	100	*More Readable*	http://www.impact-information.com/scales.pdf
Facebook	90		http://pages.trackmaven.com/rs/251-LXF-778/images/TrackMaven_Facebook_Report_2014.pdf
Alice and Wonderland	87		http://securitieseditor.com/wp/wp-content/uploads/2014/05/Plain_English_v5.pdf
Twitter - most retweeted	85		https://www.hubspot.com/hs-fs/hub/53/file-13207809-pdf/docs/science-of-retweets-201003.pdf
Median of NYT Best Sellers	80		https://www.rd.com/article/have-bestsellers-become-dumber/
Reader's Digest	65		https://www.fullmedia.com/how-do-you-measure-readability
The Sun	63		https://www.tandfonline.com/doi/full/10.1080/21670811.2012.714928

Average Simple English Wikipedia	61		https://journals.uic.edu/ojs/index.php/fm/article/view/3916/3297
Time Magazine	52		https://www.fullmedia.com/how-do-you-measure-readability
NY Post	51		https://www.tandfonline.com/doi/full/10.1080/21670811.2012.714928
Average Wikipedia Article	49		https://journals.uic.edu/ojs/index.php/fm/article/view/3916/3297
NYTimes	48		https://www.tandfonline.com/doi/full/10.1080/21670811.2012.714928
Minimum Reading Ease Score of a Florida Insurance Policy	45		https://law.onecle.com/florida/title-xxxvii/627.4145.html
WSJ	44		https://www.tandfonline.com/doi/full/10.1080/21670811.2012.714928
WaPo	43		https://www.tandfonline.com/doi/full/10.1080/21670811.2012.714928
LA Times	43		https://www.tandfonline.com/doi/full/10.1080/21670811.2012.714928
Affordable Care Act	39		https://contently.com/2015/01/28/this-surprising-reading-level-analysis-will-change-the-way-you-write/
The Guardian	33		https://www.tandfonline.com/doi/full/10.1080/21670811.2012.714928
Average SEC 10-k form	32		http://securitieseditor.com/wp/wp-content/uploads/2014/05/Plain_English_v5.pdf
Harvard Law Review	32		https://www.fullmedia.com/how-do-you-measure-readability
Scientific Journals	10	*Less Readable*	https://elifesciences.org/articles/27725#fig2

B. High School Reading List Comparison

1922 Reading List Lexile Scores

9th Grade	Lexile Score	10th Grade	Lexile Score	11th Grade (Outside Reading)	Lexile Score
Vicar of Wakefield	1290	Mill on the floss	1240	Pride And Prejudice	1190
Deerslayer	1340	Tale of Two Cities	1130	The Patrician	840
Last of the Mohicans	1230	The House of Seven Gables	1320	Adam Bede	1260
Silas Marner	1330	Kidnapped	990	Cranford	1220

Ivanhoe	1410	Two Years Before the Mast	1290	Les Miserables	1010
Captains Courageous	850	The Spy	n/a	Jane Eyre	840
The House of Seven Gables	1320	Quentin Durward	n/a	Light That Failed	n/a
Average Lexile Score	**1253**	**Average Lexile Score**	**1194**	Joseph Vance	n/a
				The Crisis	n/a
				The Bent Twig	n/a
				If Winter Comes	n/a
				Margaret Ogilvy	n/a
				Henry Esmond	n/a
				Average Lexile Score	**1060**

Original source of the 1922 Reading List:
https://archive.org/details/texashighschools01texa/page/32/mode/2up?view=theater

The 1922 reading lists have been reproduced in their entirety for full reference of material even when lexile scores are not available.

Source of Lexile Scores by Title

Title	Lexile Score Source
Vicar of Wakefield	https://www.amazon.com/Vicar-Wakefield-Dover-Thrift-Editions/dp/0486434109
Deerslayer	https://www.amazon.com/Deerslayer-Wordsworth-Classics-Fenimore-Cooper/dp/1853265527
Last of the Mohicans	https://www.amazon.com/Last-Mohicans-Wordsworth-Classics-Cooper/dp/1853260495/ref=pd_lpo_14_t_1/133-6153283-2981340?_encoding=UTF8&pd_rd_i=1853260495&pd_rd_r=07a790ac-a97f-4bef-aab9-62ecf56d921f&pd_rd_w=7Nxiu&pd_rd_wg=pa8Xi&pf_rd_p=337be819-13af-4fb9-8b3e-a5291c097ebb&pf_rd_r=BHB0VHQXM699EYZCXVSP&psc=1&refRID=BHB0VHQXM699EYZCXVSP
Silas Marner	https://www.scholastic.com/teachers/books/silas-marner-by-george-eliot/
Ivanhoe	https://www.amazon.com/Ivanhoe-Wordsworth-Classics-Collection/dp/1853262021
Captains Courageous	https://www.amazon.com/Captains-Courageous-Rudyard-Kipling/dp/0486407861
The House of Seven Gables	https://www.amazon.com/House-Seven-Gables-Thrift-Editions/dp/0486408825
Mill on the floss	https://www.teachingbooks.net/tb.cgi?tid=18001
Tale of Two Cities	https://lernerbooks.com/shop/show/13781
The House of Seven Gables	https://www.amazon.com/House-Seven-Gables-Thrift-Editions/dp/0486408825

Kidnapped	https://lernerbooks.com/shop/show/15951
Two Years Before the Mast	https://www.amazon.com/Years-Before-Mast-Signet-Classics/dp/0451531256
Pride and Prejudice	https://lernerbooks.com/shop/show/13612
the patrician	https://www.amazon.com/Patrician-John-Galsworthy/dp/116332535X
Adam Bede	https://www.amazon.com/Adam-Bede-Oxford-Worlds-Classics/dp/0199203474/ref=pd_lpo_14_t_0/133-6153283-2981340?_encoding=UTF8&pd_rd_i=0199203474&pd_rd_r=63da2655-a773-44d2-a093-4033d79de3b4&pd_rd_w=Q8ani&pd_rd_wg=0ZVhd&pf_rd_p=337be819-13af-4fb9-8b3e-a5291c097ebb&pf_rd_r=WXCXFVZQ5PTCR2Y3ZSXY&psc=1&refRID=WXCXFVZQ5PTCR2Y3ZSXY
Cranford	https://www.amazon.com/Cranford-Elizabeth-Gaskell/dp/1619492075
les miserables	https://libguides.clackamas.edu/c.php?g=655606&p=4601823
jane eyre	https://lernerbooks.com/shop/show/13598

Midland Independent School District Reading List

Midland Independent School District Reading Lists (2020-2021)

English 1 Reading List

Title	Lexile Score
All Over But the Shoutin’	880
The Book Thief	730
Anthem	780
Bury My Heart at Wounded Knee	890
The Cask of Amontillado	700
Cold Sassy Tree	740
Ender’s Game	780
Eyes of the Dragon	920
Fried Green Tomatoes	940
Joy Luck Club	990
The Martian Chronicles	930
The Other Wes Moore	930
Ready Player One	970

English 2 Reading List

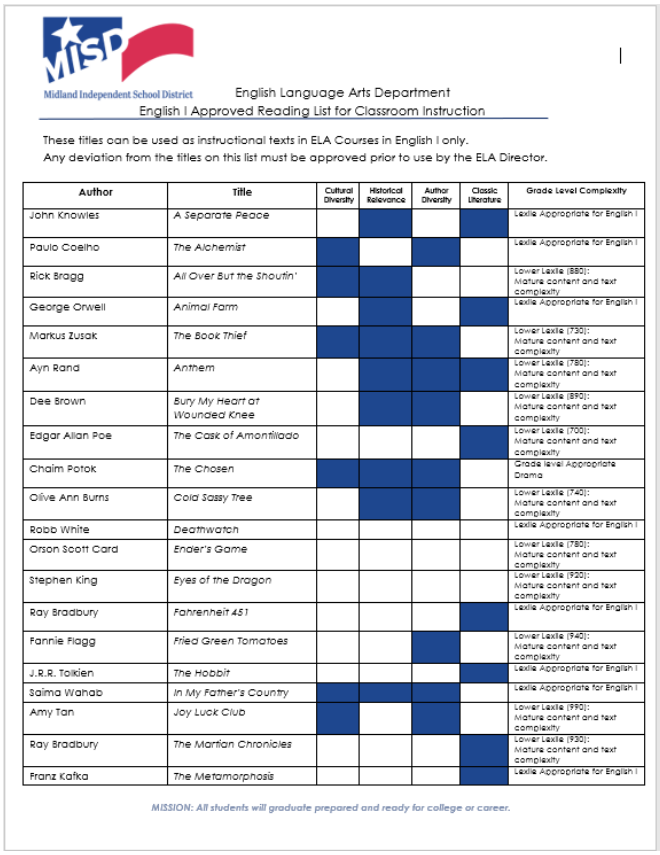
Title	Lexile Score
A Farewell to Arms	730
All the Pretty Horses	940
The Awakening	960
Bless Me, Ultima	840
Catcher in the Rye	790
The Color Purple	670
The Grapes of Wrath	680
Jane Eyre	810
Lord of the Flies	770
Miss Peregrine’s Home of Peculiar Children	890
Night	860
Old Man and the Sea	870
The Absolutely True Diary of a Part-time Indian	660

Same Kind of Different as Me	910
The Time Machine	900
Average Lexile Score	**866**

The Woman Warrior	880
Their Eyes Were Watching God	840
Things Fall Apart	890
A Thousand Splendid Suns	830
The Poisonwood Bible	960
The Help	730
The Secret Life of Bees	840
Average Lexile Score	**822**

Original source of Midland ISD reading lists: https://www.midlandisd.net/Page/24500

English I Reading List - Source May 12th 2021



Midland Independent School District

English Language Arts Department

English I Approved Reading List for Classroom Instruction

These titles can be used as instructional texts in ELA Courses in English I only.
Any deviation from the titles on this list must be approved prior to use by the ELA Director.

Author	Title	Cultural Diversity	Historical Relevance	Author Diversity	Classic Literature	Grade Level Complexity
John Knowles	*A Separate Peace*		■		■	Lexile Appropriate for English I
Paulo Coelho	*The Alchemist*	■		■		Lexile Appropriate for English I
Rick Bragg	*All Over But the Shoutin'*	■	■			Lower Lexile (880): Mature content and text complexity
George Orwell	*Animal Farm*		■		■	Lexile Appropriate for English I
Markus Zusak	*The Book Thief*	■	■	■		Lower Lexile (730): Mature content and text complexity
Ayn Rand	*Anthem*		■	■	■	Lower Lexile (780): Mature content and text complexity
Dee Brown	*Bury My Heart at Wounded Knee*		■	■		Lower Lexile (890): Mature content and text complexity
Edgar Allan Poe	*The Cask of Amontillado*				■	Lower Lexile (700): Mature content and text complexity
Chaim Potok	*The Chosen*	■	■	■		Grade level Appropriate Drama
Olive Ann Burns	*Cold Sassy Tree*		■	■		Lower Lexile (740): Mature content and text complexity
Robb White	*Deathwatch*					Lexile Appropriate for English I
Orson Scott Card	*Ender's Game*					Lower Lexile (780): Mature content and text complexity
Stephen King	*Eyes of the Dragon*					Lower Lexile (920): Mature content and text complexity
Ray Bradbury	*Fahrenheit 451*				■	Lexile Appropriate for English I
Fannie Flagg	*Fried Green Tomatoes*			■		Lower Lexile (940): Mature content and text complexity
J.R.R. Tolkien	*The Hobbit*				■	Lexile Appropriate for English I
Salma Wahab	*In My Father's Country*	■	■	■		Lexile Appropriate for English I
Amy Tan	*Joy Luck Club*	■		■		Lower Lexile (990): Mature content and text complexity
Ray Bradbury	*The Martian Chronicles*				■	Lower Lexile (930): Mature content and text complexity
Franz Kafka	*The Metamorphosis*				■	Lexile Appropriate for English I

MISSION: All students will graduate prepared and ready for college or career.

Edith Hamilton	*Mythology*		■	■	■	Lexile Appropriate for English I
Guy de Maupassant	*The Necklace*	■				Lexile Appropriate for English I
Homer	*The Odyssey*		■		■	Lexile Appropriate for English I
Wes Moore	*The Other Wes Moore*	■	■	■		Lower Lexile (930): Mature content and text complexity
Ernest Cline	*Ready Player One*					Lower Lexile (970): Mature content and text complexity
William Shakespeare	*Romeo and Juliet*		■		■	Lexile Appropriate for English I
Ron Hall, Denver Moore, & Lynn Vincent	*Same Kind of Different as Me*	■		■		Lower Lexile (910): Mature content and text complexity
H.G. Wells	*The Time Machine*				■	Lower Lexile (900): Mature content and text complexity
Harper Lee	*To Kill A Mockingbird*	■	■	■	■	Lexile Appropriate for English I
Velma Wallis	*Two Old Women*		■	■		Lexile Appropriate for English I

MISSION: All students will graduate prepared and ready for college or career.

English II Reading List - Sourced May 12th 2021

Midland Independent School District

English Language Arts Department

English II Approved Reading List for Classroom Instruction

These titles can be used as instructional texts in ELA Courses in English II only.
Any deviation from the titles on this list must be approved prior to use by the ELA Director.

Author	Title	Cultural Diversity	Historical Relevance	Author Diversity	Classic Literature	Grade Level Complexity
Ernest Hemingway	*A Farewell to Arms*				■	Lower Lexile (730L): Mature content and text complexity
Cormac McCarthy	*All the Pretty Horses*	■				Lower Lexile (940L): Mature content and text complexity
Sophocles	*Antigone*				■	Lexile appropriate for English II
Kate Chopin	*The Awakening*			■	■	Lower Lexile (960L): Mature content and text complexity
Rudolfo Anaya	*Bless Me, Ultima*			■	■	Lower Lexile (840L): Mature content and text complexity
J.D. Salinger	*Catcher in the Rye*				■	Lower Lexile (790L): Mature content and text complexity
Alice Walker	*The Color Purple*	■		■	■	Lower Lexile (670L): Mature content and text complexity
John Steinbeck	*The Grapes of Wrath*				■	Lower Lexile (680L): Mature content and text complexity
Charles Dickens	*Great Expectations*				■	Lexile appropriate for English II
Kurt Vonnegut, Jr.	*Harrison Bergeron*					Lexile appropriate for English II
Maya Angelou	*I Know Why the Caged Bird Sings*	■		■	■	Lexile appropriate for English II
Charlotte Bronte	*Jane Eyre*			■	■	Lower Lexile (810L): Mature content and text complexity
William Shakespeare	*Julius Caesar*				■	Grade level appropriate drama
Sir James Knowles	*The Legends of King Arthur*					Lexile appropriate for English II
William Golding	*Lord of the Flies*				■	Lower Lexile (770L): Mature content and text complexity
William Shakespeare	*Macbeth*				■	Grade level appropriate drama
Euripides	*Medea*	■		■		Lexile appropriate for English II
William Shakespeare	*The Merchant of Venice*				■	Grade level appropriate drama
Ransom Riggs	*Miss Peregrine's Home of Peculiar Children*					Lower Lexile (890L): Mature content and text complexity
Marion Zimmer Bradley	*Mists of Avalon*			■		Lexile appropriate for English II
Edith Hamilton	*Mythology*			■	■	Lexile appropriate for English II
Frederick Douglas	*Narrative of the Life of Frederick Douglas*	■	■	■	■	Lexile appropriate for English II

Elie Wiesel	*Night*	■	■	■	■	Lower Lexile (860L): Mature content and text complexity
Ernest Hemingway	*Old Man and the Sea*				■	Lower Lexile (870L): Mature content and text complexity
Thorton Wilder	*Our Town*				■	Grade level appropriate drama
Edgar Allan Poe	*The Pit and the Pendulum*					Lexile appropriate for English II
Shirley Jackson	*The Possibility of Evil*			■		Lexile appropriate for English II
Gabriel Garcia Marquez	*Strange Pilgrams*	■		■		Grade level appropriate text (Lexile Measure not Available)
Sherman Alexie	*The Absolutely True Diary of a Part-time Indian*	■	■	■		Lower Lexile (660L): Mature content and text complexity
Yukio Mishima	*The Sound of Waves*	■		■		Grade level appropriate text (Lexile Measure not Available)
Maxine Hong Kingston	*The Woman Warrior*			■		Lower Lexile (880L): Mature content and text complexity
Zora Neale Hurston	*Their Eyes Were Watching God*	■	■	■		Lower Lexile (840L): Mature content and text complexity
Ray Bradbury	*There Will Come Soft Rains*					Lexile appropriate for English II
Chinua Achebe	*Things Fall Apart*	■		■		Lower Lexile (890L): Mature content and text complexity
Reginald Rose	*Twelve Angry Men*		■			Grade level appropriate drama
Khaled Hosseini	*A Thousand Splendid Suns*	■		■		Lower Lexile (830L): Mature content and text complexity
Margot Lee Shetterly	*Hidden Figures*	■		■		Lexile appropriate for English II
Barbara Kingsolver	*The Poisonwood Bible*			■		Lower Lexile (960L): Mature content and text complexity
Kathyrn Stockett	*The Help*	■	■	■		Lower Lexile (730L): Mature content and text complexity
Sun Monk Kidd	*The Secret Life of Bees*	■		■		Lower Lexile (840L): Mature content and text complexity
Charles Frazier	*Cold Mountain*		■			Lexile appropriate for English II
Malcolm Gladwell	*Outliers: A Story of Success*	■				Lexile appropriate for English II

MISSION: All students will graduate prepared and ready for college or career.

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