How Much Is Too Much Reading for Medical Students? Assigned Reading and Reading Rates at One Medical School

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Abstract

Purpose

To determine how medical students' reading rates affect their ability to complete assigned reading.

Method

The authors calculated the total amount of reading assigned during 71 weeks in 12 modules of the preclinical basic science curriculum at Mercer University School of Medicine for the 2009–2010 academic year. In September 2010, they surveyed the 351 enrolled students, asking them to estimate their reading rates, number of hours spent reading each day, and the amount of the assigned reading they had completed. The authors used the data collected to estimate time required to complete the reading assignments over a range of reading rates and compared these rates with previously published reading rates.

Results

Faculty assigned 29,239 pages of reading across the modules. The 104 respondents (30% response rate) reported they could read an average of 6 hours per day. The authors calculated that 17% of the students read no faster than 150 words per minute (WPM), whereas another 66% did not exceed 100 WPM. If students reserved the last week of each module for review prior to an examination, they would need to read 496 pages per week, which would require 28 to 41 hours per week at these rates, to complete the assigned reading only once.

Conclusions

Medical students require significant time to complete assigned reading just once at the reading rates required to comprehend the cognitively challenging material. Before assigning reading, faculty should consider the amount that could reasonably be accomplished by their students.

The amount of medical knowledge continues to expand exponentially, and medical students confront a knowledge explosion within their curricula. Individual medical school faculty charged with selecting, developing, and deploying their students' learning resources may have little knowledge of students' assignments from other faculty, and they may consider their own discipline or interests more important than those of others. In such an environment, unregulated expansion of learning resources assigned to students is likely to occur.

Although there is a body of literature that describes the process of reading and reading rates, little has been published on reading loads and rates among medical students. As students are asked to learn more and more, it is important to understand how much time it takes medical students to read their assigned materials and how that affects their cognitive load in the medical school curriculum. In this study, we assessed the impact of assigned reading at Mercer University School of Medicine on student time based on reading rates commensurate with the difficulty level of medical text.

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Background

Researchers have previously estimated reading rates of students who are faced with highly complex text that they must comprehend sufficiently to pass difficult high-stakes examinations. Using research conducted on college students, Carver[1] categorized the reading process into five levels and reading rates according to how much textual content the reader can take in, process, and comprehend (Table 1). These standard measured reading rates, calculated in words per minute (WPM), are based on an average word length of six characters and a sentence length of 16.67 words.[1]

As students progress from grade school through college, they default to reading level 3 (or 300 WPM) for nontechnical, nonscientific material, and they tend to remain at level 3 even as the content being read becomes more familiar. Cognitive processes applied to reading and understanding words do not improve significantly after reaching college level. When students must read text that includes new words or concepts, however, the unfamiliar vocabulary forces them to move to a lower reading level.[2]

If students believe they will be able to correctly answer at least 75% of examination questions drawn from their reading, they will default to level 3 (300 WPM); if not, they will shift down to level 2. At level 2 (200 WPM), students learn and remember key ideas, so they may concentrate longer and harder on each word, reread phrases, reread whole sentences, or try to rephrase sentences for greater understanding. However, if the text difficulty is so great that students reading at level 3 believe they will be able to answer less than 50% of examination questions correctly, then they will shift down to level 1 (150 WPM) to memorize information. At higher reading levels, students skim

Table 1
Standard Reading Levels and Rates in Words Per Minute (WPM)*

Reading level	Average reading rate (WPM)	Purpose for reading
1	150	Memorizing for recall and recitation
2	200	Learning to remember key ideas
3	300	Comprehending whole sentences in context
4	450	Skimming to comprehend some connected words
5	600	Scanning to recognize just a few target words

* Adapted from a study of average reading rates among college students: Carver RP. Reading rate: Theory, research, and practical implications. Journal of Reading. 1992;36:84–95. Copyright © 1992 by the International Reading Association, www.reading.org. Used by permission of the publisher.

(level 4; 450 WPM) or scan (level 5; 600 WPM) the text, losing equal amounts of both important and unimportant information.[1,3]

Reading comprehension, therefore, shows a consistent decline with increased reading rate and can also be estimated as a function of both the accuracy and difficulty level of the material being read. Goldstein[4] found that when reading complex text at the highest difficulty levels, readers' accuracy rate (i.e., their ability to comprehend at least 75% of the text at 300 WPM) dropped below 10%. Carver[5] showed that when the difficulty level of reading material was matched to the reader's ability, 53.7% of readers demonstrated comprehension of text at 300 WPM, which suggests that complex text must be reread in order to gain comprehension.

A conservative estimate of words per page for the average college-level textbook is 500 (based on 267,000 words per standard academic textbook, printed on 500 pages measuring 7" × 10", or 534 words per page).[6] Reading at a rate of 100 WPM, a reader would require five minutes for a single, 500-word page of text and would be able to complete 12 pages per hour. This does not take into account nontext items that may appear on the page, such as tables, graphs, charts, and figures.

Method

We calculated the total number of pages of reading assigned for the preclinical basic science curriculum at Mercer University School of Medicine during the 2009–2010 academic year and the average number of words per page. This preclinical curriculum for first- and second-year medical students spanned 71 weeks and included 12 modules (5–7 weeks in length) that encompassed all basic science disciplines.

To determine page and word counts, we referred to faculty-generated reading lists posted on the medical school's official Web site and obtained print or electronic copies of the texts. We then estimated the time students would require to complete the reading according to reading rates commensurate with the difficulty level of the medical text.

In September 2010, we sent an e-mail (and follow-up reminder) to all 351 first- through fourth-year medical students enrolled during the 2009–2010 academic year. We invited them to participate in a survey about assigned reading and provided a link to an anonymous survey that we posted on the SurveyMonkey Web site. The survey asked students to provide their current year of study and to respond to three questions regarding their preclinical curriculum:

1. What amount of the assigned reading can you complete?
2. What do you consider the average number of hours you can read per day?
3. How many pages of text per hour can you read?

We calculated responding students' reading rates and compared the results with the published reading rates described above. The Mercer University institutional review board approved this study as exempt research.

Results

Our review of the assigned basic science medical textbooks (using electronic versions to determine word counts) revealed an average of 558 words per page, 7 characters per word, and 20 words per sentence. We determined that faculty assigned 29,239 pages of reading for the 12 basic science modules that were scheduled during 71 weeks. If students were to reserve the last week of each module to review material prior to each end-of-module comprehensive examination that required a passing grade, then they would need to complete an average 496 pages per week of assigned reading across 59 weeks.

Of the 351 medical students invited to participate in the survey, 104 (30%) responded. Sixteen (15%) of the students reported they could read 2 to 4 hours per day, 58 (56%) indicated 5 to 7 hours, and 30 (29%) said 8 or more hours; the average was 6 hours per day. Fifteen (14.4%) of the students reported that they had read 100% of the assigned reading, 22 (21.1%) reported at least 90%, 53 (51.0%) reported 70% to 90%, and 14 (13.5%) reported 50% to 70%. There were no significant differences in results among the responding students by year of study.

Table 2 delineates the number of pages that students reported reading per hour, with our calculation of equivalent WPM assuming a standard 500 words per page (as a conservative estimate). Eighteen students (17%) reported reading up to 150 WPM (level 1, for memorization), but 55 (53%) read no faster than 100 WPM, and 13 (13%) read no faster than 50 WPM. To complete the assigned reading in 59

Table 2
Reading Rates Reported by 104 Medical Students at the Mercer University School of Medicine, 2010

No. (%) of students	No. of pages read per hour	Reading rate (WPM)*
13 (13%)	≤6	≤50
55 (53%)	7–12	51–100
18 (17%)	13–18	101–150
16 (15%)	19–24	151–200
2 (2%)	≥25	≥201

* The authors used students' reported pages read per hour to calculate reading rate ranges in words per minute (WPM) for a textbook averaging 500 words per page, using data from Table 1 and published reports on reading rates of professional students.[1,7–9]

weeks, students would need to read 28 to 41 hours per week at reading rates of 150 and 100 WPM, respectively, to complete the assigned reading just once. Therefore, if students spent 6 hours per day just reading—the average amount they reported—then they would need to do so for 5 to 7 days per week to complete the assigned reading only once.

Discussion

Prior research shows that a student's reading rate does not improve significantly beyond grade 12, and thus we assume that medical students will not have reading rates significantly higher than those of college students. We also assume that the number of words per page and the complexity of prose and language within medical textbooks are at least equivalent to those of college-level textbooks. On the basis of this prior research and our own survey results, we postulate that 150 WPM (level 1, memorization) is the most likely reading rate that could be achieved by medical students in their initial attempt to complete assigned reading when new vocabulary and concepts must be mastered to meet specific learning objectives in order to pass difficult examinations.[1,3]

As reported above, 83% of medical students responding to our survey reported reading no faster than 150 WPM, the lowest rate identified in prior published studies, and 53% read no faster than 100 WPM. Students who read at rates of 150 WPM or 100 WPM would require 28 or 41 hours, respectively, each week to complete the 29,239 pages of assigned reading. If students spent 6 hours per day just reading, the average amount they reported, then they would need to devote 5 to 7 days of reading time each week to completing the assigned basic science reading only once.

Carver[3] documented comparable results in a study in which college students read 500- to 600-word passages with complex content for recall. Their average reading rate was 124 WPM. When these college students were given no objectives for the assigned reading, their rate was 154 WPM; with general objectives, their rate was 135 WPM, and with specific objectives, their rate was 108 WPM.[3] Likewise, our curriculum has detailed objectives linked to specific pages of assigned reading, which likely slows students' reading rates. Similarly, in a study of a law school's curriculum, Lundeberg[7] found that expert faculty read complex legal cases that were challenging to comprehend at a rate of 198 WPM, whereas novice law students read them at just 97 WPM.

Medical school basic science texts are more difficult for students to comprehend than are the nonmedical texts that have been used in prior research to calculate standard reading rates. When new vocabulary is present and new concepts are introduced, and when tables, graphs, charts, and figures are present, then students' reading rate may drop below 100 WPM. This may explain why Taylor[8] calculated that second-year U.S. medical students averaged only six pages of reading per hour (50 WPM), and why Friedberg and colleagues[9] found that second-year-equivalent Israeli medical students read eight pages per hour (67 WPM).

Reading ability and the corresponding reading level may be based on an individual's ability to access memory codes for visual representations at more abstract levels of analysis. Faster readers, therefore, recognize more letters and words from the visual pattern of text in a given amount of time. Faster readers' memory access speed advantage reflects a more general speed advantage for accessing memory codes of any visual pattern having a learned abstract representation.[10]

Thus, the reading level may impact the cognitive load of the text. Cognitive load theory assumes readers have limited working memory that can hold five to nine novel information elements obtained from sensory input and actively process two to four elements simultaneously for no longer than a few seconds. Readers will lose almost all information after about 20 seconds unless it is refreshed by rehearsal. Slower readers refresh information more slowly. A novice student, for example, may not reach the end of a sentence without forgetting novel words that appeared at the beginning of the sentence. Long-term memory reduces working memory load through use of cognitive schemas that organize knowledge and facilitate reasoning using many information elements simultaneously. Working memory load may be affected by the intrinsic nature of the learning tasks (intrinsic load), by the manner in which the tasks are presented (extraneous load), and by the learning that actually occurs (germane load) when dealing with intrinsic load. Intrinsic and extraneous cognitive loads are additive.[11]

Learners may go through multiple cycles of learn–forget before new information is encoded into their long-term memory, which supplies information that is not limited to just a few items at a time. Experts have many informational items encoded in their long-term memory in schemas that can be quickly recalled and applied. They automatically use extensive long-term memory banks, whereas novices struggle to process new information with short-term memory. Expert faculty may therefore expect novice students to complete large amounts of assigned reading without realizing how long it will take students to process the information.[11]

Educational tasks that require extensive reading increase extraneous load through split attention resulting from spatial and temporal contiguity effects. Poor spatial contiguity forces the student to search for and match mutually referring but disparate elements of information (e.g., text, tables, images, diagrams) across multiple pages. Temporal contiguity occurs when multiple sources of information necessary for comprehension are separated in time—that is, when students must devote mental resources to recall words on another page of text or in another textbook.[12]

Intrinsic load increases as reading material becomes more complex. Intrinsic load can be reduced through simplifying reading material by decreasing the number of information elements and reducing element interactivity (the degree to which the elements can or cannot be understood in isolation). For example, a paragraph with many novel terms and concepts has high element interactivity because the elements cannot be understood in isolation. Intrinsic load is reduced when schemas are developed that incorporate the interacting elements. Expert faculty can reduce students' intrinsic load by condensing assigned

textbook reading into explanatory statements in teaching sessions and written synopses (e.g., handouts with simpler phases) to present concepts to students as schemas, a process that may be termed "spoon feeding."[11]

Students must address intrinsic load by choosing among surface, strategic, or deep learning strategies. Surface learners concentrate on rote learning of content and focus on the short-term goal of passing a course or module. Strategic learners focus on learning content perceived to be "high yield" for the highest grade on the next examination. Deep learners employ learning processes that relate facts and concepts to evidence and make links that allow them to integrate knowledge across subject matter. They strive to attain a deeper understanding of the material, identify general principles, take an interest in the content, and seek to become able to apply it.[13]

Although faculty may want students to become deep learners, by assigning a substantial reading load, they may instead force students to adopt surface or strategic learning strategies to pass the next examination. Moreover, a study of medical students in a longitudinal course showed that completion of reading assignments fell from 73% to 8% when no examination covered assigned reading.[14] The consequences of surface and strategic learning strategies may be similar to those of running up credit card debt—students' cumulative knowledge deficits must eventually be paid with additional study at a later time. Students who attempt to filter their reading by skimming or scanning must also be on guard against "ambush"-style assessments, such as examinations containing questions about obscure facts or features buried within the reading assignments.

In Mercer's preclinical basic science curriculum, the majority of contact hours are delivered through a tutorial-style, problem-based learning curriculum that averages fewer than five lecture hours per week. However, lectures generate additional paper handouts, electronic files, and videos that students may feel compelled to review. We did not estimate student time devoted to such resources, nor did we estimate the time students may spend seeking and using additional resources (e.g., board review books, computer-aided instructional programs, Web sites). The additional time required is likely greater than that documented in the era before the Internet and cell phone by Taylor,[8] who estimated that medical students needed 175 hours per week to accomplish all curricular and noncurricular activities. We therefore encourage faculty at other medical schools to calculate their own assigned reading loads before dismissing our results as an outlier in medical education.

Table 3

Estimated Hours Required to Complete Assigned Reading Based on Number of Pages Assigned*

	Hours required at reading rate in words per minute (WPM)			
Pages of assigned reading	50 WPM	100 WPM	150 WPM	200 WPM
500	83	42	28	21
1000	167	83	56	42
1500	250	125	83	63
2000	333	167	111	83
2500	417	208	139	104

* Estimates calculated for potential reading loads and reading rate, assuming there are 500 words per page of text.[1–3]

Table 3 details the time in hours required to complete reading assignments in proportion to the amount of reading assigned and the reading rate of the student. If curricular contact hours per week remain constant while pages of assigned reading increase, then additional hours spent reading reduce time for review, remediation, and extracurricular activities such as service learning, research, student organizational activities, and clinical experiences.

Faculty may oppose "spoon feeding" and prefer that students obtain information firsthand through assigned reading. However, novice students may not be able to spontaneously identify the textual information deemed important by a faculty expert (and therefore likely to appear on an examination), even while reading at 50 WPM or rereading the text. If expert faculty will abstract the key information from assigned reading and present it to students, some assigned reading may become redundant.

Educators who follow a constructivist approach may believe that learners need to construct their own knowledge after being presented with goals and minimal information, because providing too much guidance may impair students' later performance. Educators may also confuse learning a discipline with practicing a discipline, thereby making no distinction between the behaviors and methods of experts and those of novice students. However, educational research based on human cognitive architecture supports providing direct, strong instructional guidance for novice to intermediate learners. Unguided instruction is less effective and may have negative results if students acquire misconceptions or incomplete or disorganized knowledge.[15]

Conclusions

In summary, our results show that the volume of reading assignments in our medical school's preclinical basic science curriculum challenges students' capacity to complete the reading. At best, most students reported reading no faster than 150 WPM. Students probably read at a slower rate when new vocabulary and concepts are present, and when they take time to interpret nontextual content (e.g., tables, graphs, charts, figures). When assigned readings are high in page count, students must choose either to skip some assigned reading or to sacrifice other curricular and noncurricular activities to spend more hours per day and/or more days per week reading. Only 14% of our respondents reported that they had completed all assigned reading. Faculty

at other medical schools should be aware that their students will also read at these rates to learn and memorize content to achieve the high levels of comprehension needed to pass examinations. Faculty should be cognizant of the time demands on their students within these parameters and adjust reading assignments to promote deep learning.

We offer the following recommendations for overcoming challenges to reducing medical students' reading load. First, expert faculty should formulate concise learning objectives and identify corresponding reading assignments. Next, they should limit reading assignments to an amount appropriate for the study hours available (e.g., 180 pages/week = 15 hours/week at a reading rate of 100 WPM). They should provide focused verbal and written synopses of reference reading sources to guide student study. Finally, they should match clinically relevant assessments to the learning objectives. Further research could compare the cognitive capacity necessary to gain deep understanding from current medical school curricula with that necessary to effectively function as a medical professional.

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