

Use of a Supplementary Internet Based Education Program Improves Sleep Literacy in College Psychology Students

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SCIENTIFIC INVESTIGATIONS

Introduction: Knowledge regarding the importance of sleep in health and performance and good sleep hygiene practices is low, especially among adolescents and young adults. It is important to improve sleep literacy. Introductory psychology is one of the most highly enrolled courses at colleges and universities. This study tested the impact of an Internet-based learning module on improving sleep literacy in this venue.

Methods: An Internet-based supplementary learning module containing sleep physiology and hygiene information was developed using content from the Harvard Medical School sleep educational website <http://www.understandingsleep.org>. Access to the module was provided as an extra credit activity for 2 of 4 sections (Supplemental Sleep, SS, N = 889) of an introductory college psychology course during their standard instruction on sleep and dreaming. The remaining 2 sections (Standard Instruction, SI, N = 878) only were encouraged to visit the website without further direction. Level of knowledge was assessed before and after availability to the module/website and at the end of the semester. Students were asked to complete a survey at the end of the semester inquiring whether they made any changes in their sleep behaviors.

Results: Two hundred fifty students participated in the extra credit activity and had data available at all testing points. Students in the SS Group had a significant improvement in sleep knowledge test scores after interacting with the website in comparison to the SI group (19.41 ± 3.15 vs. 17.94 ± 3.08 , $p < 0.001$). This difference persisted, although at a lower level, at the end of the semester. In addition, 55.9% of the SS group versus 45.1% of the SI group indicated that they made changes in their sleep habits after participation in the extra credit sleep activity ($p < 0.01$). The most common change was a more consistent wake time.

Conclusion: Use of a supplementary internet-based sleep learning module has the potential to enhance sleep literacy and change behavior among students enrolled in an introductory college psychology course.

Keywords: Internet learning, psychology, sleep hygiene, instruction

Citation: Quan SF; Anderson JL; Hodge GK. Use of a supplementary internet based education program improves sleep literacy in college psychology students. *J Clin Sleep Med* 2013;9(2):155-160.

Poor sleep habits are common among college students, and the prevalence of sleep problems is high.¹⁻³ In a recent survey of students at a large public university, 33% of respondents had a sleep latency of more than 30 min, and a similar percentage reported being tired during the day.² Approximately half of those surveyed reported using a sleep aid (white noise, fan, music, medication). Not surprisingly, energy drink consumption among college students also is high, with 51% using more than one drink per month. Two-thirds of those using energy drinks did so to mitigate the effects of insufficient sleep.⁴

Although there is some recognition among educators of the benefits of promoting better sleep habits among college students,⁵ there is a lack of healthy-sleep promotion activities on most college campuses. One institution, Stanford University offers an introductory sleep course⁶; however, at most colleges and universities, formal instruction is not common. More frequently, a small amount of academic instruction in sleep is included in introductory psychology courses. These courses are among the most highly enrolled at most colleges and universities, often with several hundred students per semester. Thus they potentially provide a mechanism to increase education

BRIEF SUMMARY

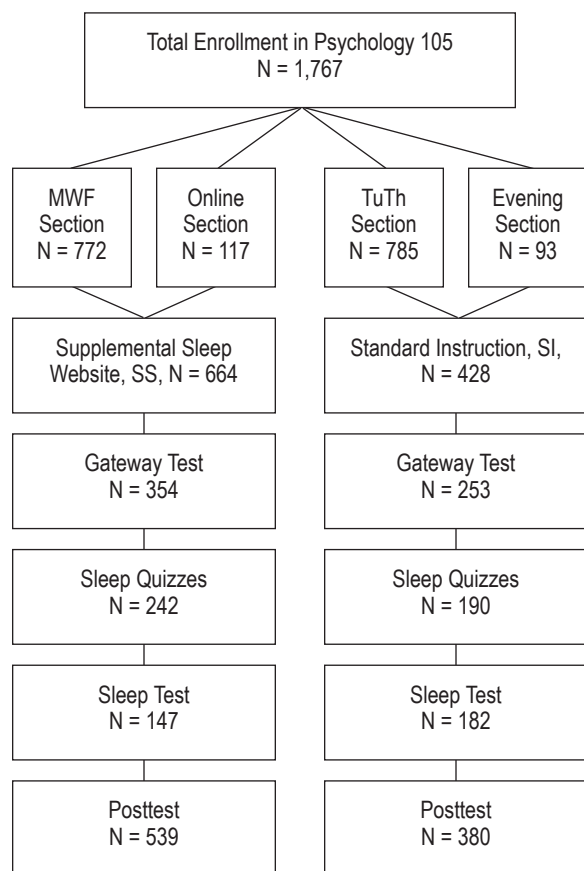
Current Knowledge/Study Rationale: Knowledge regarding the importance of sleep in health and performance and good sleep hygiene practices is poor among college students. This study assessed whether addition of a structured internet-based learning module to standard instruction would improve sleep knowledge and change sleep behavior in students enrolled in an introductory college psychology course.

Study Impact: This study demonstrated that students who used a structured internet-based learning module focused on sleep had greater improvement in their sleep knowledge and were more likely to change their personal sleep behavior in comparison to non users. These findings suggest that use of the internet to supplement sleep instruction in this venue has the potential to enhance sleep knowledge and favorably change sleep behavior among college students.

pertaining to healthy sleep.⁷ Unfortunately, the amount of time devoted to information about sleep in these courses may be as little as one hour of lecture.

In the past 10 years, use of the Internet among all segments of the population has been increasing rapidly. Educational uses have been growing and online college courses and degree programs are offered by many prestigious institutions. Educational

Figure 1—Flow diagram showing the sequence of testing and the number of participating students at each assessment point.



All students irrespective of whether they participated in the extra-credit activity were eligible to take the Posttest.

effectiveness of online instruction has begun to be documented.⁸ Often within traditional educational venues, online instruction is incorporated alongside standard methods of instruction such as lectures, seminars, and assigned reading.

The purpose of this study was to assess the impact of a structured supplemental online instructional module on improving sleep literacy in college students. Specifically, we provided access to a sleep education module to students in an introductory psychology course at the University of New Mexico (UNM). We tested the hypothesis that use of our structured supplemental education website would enhance sleep-related knowledge relative to standard instruction plus access to a sleep informational website without any structured presentation of the information.

METHODS

Subjects

Approximately 3,000 students take introductory psychology at UNM each year. Most students who register are not psychology majors but enroll because it fulfills the Social and Behavioral Sciences course requirement for the undergraduate core curriculum; it is a choice among several required courses of

this type. Freshmen enrollment in the course reflects that of the university as a whole: an undergraduate minority student population of approximately 46.4% (31.3% Hispanic, 5.5% Native American, and 9.6% other), with many students representing low-income, first-generation college students, living off campus, and working ≥ 30 hours a week.

For the study in the fall 2010 semester, 889 students from 2 sections (one was an online section), were eligible to receive online supplementary instruction on sleep; 878 students from 2 sections (one was an evening section) were eligible to access a sleep informational website, but receive no structured supplemental instruction.

Standard Instruction

Over approximately 7 days, spanning the fourth through fifth weeks of the course, all introductory psychology students received lectures on consciousness and sleep (total lecture time was 150 minutes distributed over 2 or 3 lectures, depending on lecture meeting times). The lecture material on sleep—as opposed to dreams, attention, drugs, etc.—constituted one-third of the lecture time, or approximately 50 minutes. The lectures followed the topics presented in the required textbook (David G. Myers, 2011, *Exploring Psychology*, 8th ed., Worth Publishers, New York).

In this course, repetitive quizzing is used as a learning tool, a method found by us and reported by others to enhance learning.⁹⁻¹¹ In addition to reading the chapter in the textbook, students were required to complete 3 timed online mastery quizzes weekly, consisting of 20 randomly-drawn questions, and a chapter test made of 50 random questions similar to but not identical with the quiz questions. The 20-question quizzes were drawn from a database of 3,000 quiz questions taken from the required textbook's test-item file (J. Brink, 2008/2011, *Test Bank Volume 1 to accompany Myers Exploring Psychology*, 7th/8th eds., Worth Publishers, New York), and covered virtually all of the textbook material.

To achieve high point totals, students took the 3 sets of randomly generated quizzes multiple times (each quiz was different from every other) in order to master chapter material and do well on weekly chapter tests (J. Brink, 2008/2011, *Test Bank Volume 2 to accompany Myers Exploring Psychology*, 7th/8th eds., Worth Publishers, New York). Only the highest quiz score counted toward the course grade, which consisted of 2,400 total possible points. Mastery quiz points counted one-third of their grade; chapter tests, one-third; four quarterly exams and a final exam counted one-sixth; the remaining points came from in-class participation ($i >$ Clicker student-response system; <http://www.iclicker.com/>) and research credits (either participating in experiments or writing research reports on journal articles). Except for in-class participation, all assessments were delivered, completed, and scored online in WebCT Vista (Blackboard Inc., Washington, DC). Although different instructors were used, the curriculum across all sections was the same and lectures were based on a fixed set of Keynote (Apple, Inc., Cupertino, CA) slides.

Sleep Instructional Intervention and Assessment Procedures (Figure 1)

In order to obtain a baseline assessment, all students were provided access to a 28-item "Pretest" Quiz (*vide supra*) for extra credit early in the semester (before any course instruction

regarding sleep). Later, as they began covering the chapter on consciousness which includes information on sleep, students were informed of the availability of an extra-credit sleep module. In 2 of the 4 sections of the course, the extra-credit sleep module was based on our supplemental structured website. The other 2 sections were given only a link to the general sleep-information website, www.understandingsleep.org, without any structured presentation of information. In all other respects, both extra-credit sleep modules were incorporated into the course in a similar manner to other extra-credit activities.

All sections of the course utilize WebCT to provide students with study material including quizzes, tests, and extra credit activities. Throughout the semester, students locate study material by clicking on icons on the course Home Page. An icon for the sleep extra-credit material was available throughout the weeks when the classroom lectures covered the chapter on consciousness. No changes were made to the usual lecture or quiz content on sleep.

Each student who clicked on the icon for the extra credit sleep activity received a series of instructions. The first was to click a link for supplemental information about sleep. After accessing this supplemental website or being informed of the availability of the non-structured sleep informational website, the student was directed back to WebCT for a 28-item "Gateway" Test, which was identical for experimental and control groups. Scores on that test therefore provided an assessment of the added value of our structured sleep educational website, in comparison to standard course instruction in sleep with availability of a general website containing similar information about sleep and health.

After completing the Gateway Test, students then could go on to accumulate extra-credit points by taking a "Sleep Quiz," which served as a practice quiz because it could be taken multiple times without feedback. After a student used the Sleep Quiz to study, the student could take a "Sleep Test" one time. The amount of extra credit earned was based on the student's score on this 28-item Sleep Test.

At the end of the semester, all students had the opportunity to earn additional extra-credit by taking a Sleep "Posttest." At that time, students also were surveyed about whether they participated in the extra-credit activities and whether they had made any changes in their sleep habits as a result of participation. If they had made changes, they were asked to list them.

Supplemental Sleep Module

Content for the online supplemental sleep educational module was derived from the Harvard Medical School Division of Sleep Medicine's Sleep and Health Education Program's educational websites (www.understandingsleep.org). The module for our sleep educational intervention contained sleep content in 10 instructional subtopics as follows:

- (1) External Factors that Influence Sleep: Building Good Habits
 - (a) Effects of Caffeine
 - (b) Effects of Alcohol
 - (c) Setting a Consistent Sleep Time
 - (d) Impact of Medications
- (2) Sleep and Cognition
 - (a) Memory
 - (b) Reaction Time

- (3) Biological Rhythms
- (4) Sleep Disorders
 - (a) Insomnia
 - (b) Obstructive Sleep Apnea
 - (c) Sleep Evaluations

Each subtopic included a scenario (see **Appendix** for an example) followed by a 4-item multiple-choice question. After selecting one of the answers, a student received feedback that consisted of a short video or text containing content relevant to the question. After viewing the feedback, the student returned to the module which then displayed the statement: "Based on what you learned in the video/text, do you want to change your answer to the question?" Following this instruction, the student went to a small number of multiple-choice questions. Each student had the same number of items which varied from 2-5 across the subtopics. The student was required to complete these quiz items to get to the next subtopic (*vide infra*, *Assessments*). At the conclusion of the final subtopic, the student was directed back to the course website where quizzes and tests could be submitted for extra credit.

Assessments

Across the 10 subtopics of the Educational Module, 28 instructional points (e.g., "effects of caffeine on sleep quality" or "interaction between circadian and homeostatic forces") were used to create quiz items. For each of the 28 instructional points, 5 quiz questions were constructed to focus on that point. From this pool of questions, five 28-item quizzes were created. Thus, each of these assessed all 28 instructional points in our educational module, with the specific test items not repeated across the different quizzes.

Data Analyses

Student's unpaired *t*-test was used to compare quiz performance between the group who had viewed the online sleep educational website and the group who only had availability to a general sleep website at 4 time points: Pretest, Gateway Test, Sleep Test, and Posttest. Because some students did not complete all of the quiz assessments, multivariate repeated measures analysis of variance was used to evaluate performance over time for students who completed all 4 quizzes. All analyses were performed using IBM SPSS Statistics Version 19 (Chicago, IL). Data are presented as mean \pm SD.

RESULTS

In **Table 1** is shown the performance on sleep quizzes at the Pretest, Gateway Test, Sleep Test, and Posttest time points for all students who participated in the extra credit activity ($N = 1,092$). At the initial Pretest assessment, performance was slightly worse for students who eventually would have access to the supplemental sleep website (SS Group, $N = 664$) than those students who would receive standard instruction (SI Group, $N = 428$). However, at the Gateway Test assessment point, there was a significant improvement in performance by those students in the SS Group (23.93 ± 4.35 vs. 18.35 ± 3.85 , $p < 0.01$) that persisted, albeit at a lower level through to the Posttest assessment (19.35 ± 4.00 vs. 18.87 ± 3.75 , $p = 0.07$). In contrast, there was little change in the SI Group.

Table 1—Performance of all students on sleep knowledge assessments

	Pretest ^a	Gateway Test ^b	Sleep Test ^b	Posttest ^c
Supplemental Sleep Website, (SS Group)				
Mean	17.23	23.93	23.80	19.35
N	664	354	147	539
SD	4.00	4.35	1.92	4.00
Standard Instruction, (SI Group)				
Mean	17.81	18.35	19.69	18.87
N	428	253	182	380
SD	3.64	3.85	3.62	3.75

^a $p < 0.05$ Supplemental Sleep Website vs. Standard Instruction. ^b $p < 0.01$ Supplemental Sleep Website vs. Standard Instruction. ^c $p = 0.07$ Supplemental Sleep Website vs. Standard Instruction. SD, standard deviation.

Table 2—Performance of students who completed all sections of the extra credit sleep module

	Pretest	Gateway Test	Sleep Test	Posttest
Supplemental Sleep Website (N = 123)				
Mean	19.41 ^a	26.64 ^{a,b}	23.90 ^{a,b}	22.84 ^{a,b}
SD	3.15	1.45	1.88	2.54
Standard Instruction (N = 127)				
Mean	17.94	18.29	19.35 ^b	19.95 ^b
SD	3.08	3.91	3.65	3.56

^a $p < 0.001$ Supplemental Sleep Website vs. Standard Instruction. ^b $p < 0.001$ versus Pretest. SD, standard deviation.

Table 3—Changes in performance on sleep knowledge tests compared to pretest values

	Absolute Change From Pretest			Adjusted Change From Pretest ^c		
	Gateway Test-Pretest ^a	Sleep Test-Pretest ^a	Posttest-Pretest ^a	Gateway Test-Pretest ^a	Sleep Test-Pretest ^a	Posttest-Pretest ^a
Supplemental Sleep Website (N = 123)						
Mean	7.23	4.49 ^b	3.42 ^b	7.74	5.00 ^b	3.82 ^b
SD	3.38	3.29	3.02	2.84	2.79	2.76
Standard Instruction (N = 127)						
Mean	0.35	1.41 ^b	2.01	-0.15	0.91 ^b	1.63 ^b
SD	3.67	3.67	3.32	2.84	2.79	2.76

^a $p < 0.001$ Supplemental Sleep Website vs. Standard Instruction. ^b $p < 0.01$ versus Gateway-Pretest. ^cValues adjusted for Pretest scores. SD, standard deviation.

Inasmuch as many students did not have quiz scores at all of the assessment points, in **Table 2** is shown the data for only those students (N = 250) who had quiz scores at all 4 assessment points. For these students, performance of the SS Group was higher at the Pretest assessment point in comparison to the SI Group (19.41 ± 3.15 vs. 17.94 ± 3.08, $p < 0.001$). However, similar to the data for all students, quiz performance was superior for the SS Group at all subsequent assessment points versus the SI Group. Nonetheless, for the SI Group at the Sleep Test and Posttest assessment points, there was a small improvement in quiz performance in comparison to the Pretest assessment point. This was not present at the Gateway Test assessment point. Additional analyses determined that overall student performance based on total points accrued during the entire semester was not a factor in determining scores on the sleep quizzes (data not shown).

In order to ascertain whether the difference in initial quiz scores between the two groups at the Pretest assessment was responsible for the better subsequent performance of the SS

group, the absolute change in score from the Pretest value to the Gateway Test, Sleep Test, and Posttest assessment points was computed. As shown in **Table 3**, the magnitude of change was much larger for the SS group than the SI group. Adjustment for Pretest score in the analysis did not alter these findings (change at Gateway Test: 7.74 ± 2.84 vs. -0.15 ± 2.84, $p < 0.01$).

At the end of the semester, all students were surveyed to determine what if any changes they made with respect to their personal sleep hygiene: 55.9% of the SS group in comparison to 45.1% of the SI indicated that they made changes in their sleep habits after participation in the extra credit sleep activity ($p < 0.01$). Additionally, students in the SS group in comparison to the SI group more often indicated that they now had a more consistent wake time (22.1% vs. 14.6%, $p < 0.05$) or had made several changes in their sleep habits including trying to get more or better sleep (12.3% vs. 7.1%, $p < 0.05$). In contrast, those in the SI group more often endorsed nonspecifically trying to get more or better sleep (14.3% vs. 7.8%, $p < 0.01$).

DISCUSSION

In this study, we have shown that a structured supplemental Internet-based instructional module resulted in a longer lasting improvement in sleep-related knowledge than standard instruction in an introductory college psychology course. Importantly, at the end of the semester, the supplemental instruction had a greater impact in changing personal sleep behavior than standard instruction.

The major finding from this study is that online supplemental instruction can improve the acquisition of sleep-related knowledge in an introductory college psychology class. At UNM, formal instruction in sleep-related topics constituted only approximately 50 minutes of lecture time. Furthermore, only 17 of 721 (2%) pages in the required textbook were devoted to sleep topics. It is likely that this low amount of sleep instruction occurs in other academic institutions as well. There are several reasons why consideration should be given to increasing the amount of sleep-related instruction in an introductory college psychology class. First, common psychological problems such as depression and anxiety are intimately associated with abnormalities or deficiencies in sleep particularly in college students.¹² Second, there is increasing evidence of the importance of sufficient, good quality sleep in determining both societal and personal health.¹³ Lastly, college age students are particularly susceptible to engaging in unhealthy sleep hygiene practices, and thus could benefit from greater awareness of the importance of good sleep.² Our findings suggest that supplemental instruction using the internet could provide a vehicle to increase sleep-related instruction in a college psychology course without impinging on the instructional time devoted to other topics.

Use of online instructional methods is increasing in all types of learning. The pedagogy of introductory college psychology is not an exception. There remain, however, a number of barriers to the use of online instruction. These include lack of instructor training, insufficient time for course development, and dehumanization of instruction.^{14,15} Nevertheless, in one survey, 50% of the chairs of college psychology departments used the internet to provide instruction to at least a moderate degree.¹⁴ Moreover, entire courses are now being provided only online.¹⁶ In one recent meta-analysis, despite heterogeneity among studies, time spent learning was generally the same with Internet based instruction as with face-to-face pedagogy.¹⁷ However, use of video clips, animation, and narration within the web-based instruction resulted in higher test scores and greater user satisfaction.¹⁷ A course website with interactivity also appears to enhance learning.¹⁸ Inasmuch as these features were incorporated in our supplemental module, this may have contributed to the better performance of the SS group in our study.

Our study demonstrated that by the end of the semester, a greater proportion of students who were in the SS group reported making changes in their personal sleep behavior, in particular, consistency of wake up time. This topic was specifically addressed in the supplemental website, which may be an explanation for this finding. Reported change in behavior is an important outcome because college students are a high risk population for insufficient sleep and poor personal sleep hygiene.¹⁻³ Students who were in the SS group were also more likely to report changes in more than one area and in particular, getting more or better sleep. The latter topic was also specifi-

cally addressed in the supplemental website and is a possible explanation for this finding. In contrast, students in the SI group were more likely to demonstrate understanding that getting more sleep was important, but were less likely to articulate specific strategies to achieve this goal. This suggests that merely teaching about the importance of sleep might not be as effective as providing specific instruction on how to achieve better sleep. It is also consistent with previous observations in college students that knowledge regarding good sleep hygiene does not necessarily translate into practice.¹⁹ However, it is important to note that even 45.1% of students in the SI group indicated that they were making some effort to improve their sleep. Although many students in both groups indicated on questionnaire that they had made changes in their behavior, our study did not obtain objective data (e.g., actigraphy) that this actually occurred. Nevertheless, our study is consistent with the observations by Brown et al.,²⁰ who found in a small randomized controlled study of college psychology students that a short sleep hygiene program consisting of a brief oral presentation and handouts could improve sleep hygiene practices and sleep quality. Importantly, our findings extend their results by demonstrating similar results using Internet technology in a larger cohort.

There are several limitations and caveats to our study. First, the sleep module was offered only as an extra-credit activity. Thus, only a small proportion of the students completed quizzes at all four assessment points. It is possible that this subset of students is not representative of the entire class. However, our results cannot be explained by differences in overall class performance because adjustment for this variable did not change our results. Second, there were differences in sleep-related knowledge at the baseline Pretest assessment point. We do not believe this explains our findings because the absolute difference in effect between the two groups was quite large and adjustment for the baseline difference did not alter our findings. However, even if baseline differences explained some of our between group findings, the results provide evidence that use of the Internet to provide instructional material is both viable and effective. Third, because of privacy restrictions, we were not able to do further analyses to determine whether there were any differences in the results with respect to demographic factors (i.e., gender, ethnicity, etc.). Fourth, there is some confounding of our results by the effect of repetitive quizzing, which is used as a learning tool in this course. This may be the explanation for the slight improvement at the Sleep Test and Posttest assessment points in the SI group. However, it does not account for the difference between the two groups at the Gateway Test assessment point because repetitive quizzing had not yet occurred.

In conclusion, this study demonstrates that use of supplemental online instruction devoted to sleep-related topics can improve knowledge concerning sleep and sleep health in an introductory college psychology course and increase the likelihood of students improving their personal sleep behavior. College psychology instructors should consider supplementing their pedagogy on sleep topics with an online supplemental website similar to that used in our study.

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ACKNOWLEDGMENTS

Funding for this study was provided by a grant from the American Sleep Medicine Foundation.

SUBMISSION & CORRESPONDENCE INFORMATION

Submitted for publication June, 2012

Submitted in final revised form July, 2012

Accepted for publication July, 2012

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DISCLOSURE STATEMENT

This was not an industry supported study. Dr. Anderson has received research support from Philips Healthcare Solutions and serves on the editorial advisory board of the Sleep and Health Education Program of the Division of Sleep Medicine at Harvard medical School. The other authors have indicated no financial conflicts of interest.

APPENDIX

The following is a scenario used in the supplemental sleep module to illustrate the effects of caffeine on sleep:

Scenario: Carlos is a UNM freshman He was a good student in high school, but finds college courses challenging so he is working extra hard, and it is starting to wear him out. He is studying every night. To stay alert, he drinks a can of Red Bull every hour. To unwind he has a beer. In the morning he needs 3-4 cups of coffee but still has trouble staying awake in lectures. What effect is caffeine having on his sleep?

Questions:

- a) the more he caffeine he drinks, the more alert he is
- b) caffeine in the evening makes it harder to fall asleep, so after a few days on this schedule, Carlos has fallen into a vicious cycle—he doesn't get enough sleep so he drinks more and more caffeine and then he gets even less sleep
- c) in the morning caffeine wakes a person up, but consuming caffeine in the evening would not interfere with sound sleep a few hours later
- d) caffeine has no direct physiological effects, Carlos just thinks it is making him more alert

The student chooses one of the answers and is taken to a short video at <http://healthysleep.med.harvard.edu/healthy/science/how/external-factors-which-explains-the-effects-of-caffeine>. Afterwards, the student is asked the same questions again, and given the correct answer before moving onto the next scenario.