

Getting students to AskUp:

Study strategies in a medical school class

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Introduction

Although lectures are the principal mode of teaching in universities and medical schools throughout the world, little learning actually takes place during most lectures (Brown 2014). In addition, the most common studying techniques—reviewing lecture notes or re-reading a passage—have low utility (TABLE 1) (Dunlosky 2013). Multiple studies have shown that we are unable to recognize strategies that make learning most effective.

"Practice testing," the technique of generating your own questions or taking practice tests, has been shown to be a highly effective way to study. One of the possible benefits of this technique is that it employs "retrieval practice," the act of retrieving information from memory, which greatly enhances learning (Argawal 2008, Karpicke 2011).

Learner-generated questions have been tested in a variety of settings and have been found to improve comprehension, as compared to re-reading a passage (Rosenstie 1996, Weinstein 2010) and are at least as effective as answering teacher-generated questions. Learner-generated questions have also been shown to improve lecture comprehension, as compared to reviewing lecture materials (King 1992). However, this technique is likely underused in undergraduate medical education.

This pilot study seeks to analyze the study strategies that medical students use to study for exams in a medical school class. To encourage and analyze question-generation by students, we developed a web application called AskUp, which allows learners to generate their own question and answer sets. Questions are shared anonymously with other students, giving them an opportunity to answer open-ended questions their peers have created.

We provided a short intervention that highlighted evidence-based effective study strategies, and introduced AskUp as one way to study applying retrieval practice through the generation and answering of questions. We analyzed whether our intervention was effective in changing study habits.

Methods

HMS students enrolled in the Integrated Human Physiology class were invited to participate. Electronic surveys to assess exam study methods were sent to students after each of their three examinations. Study methods were mapped to Dunlosky's evaluation of effective study techniques. After the first and second examination, we briefly introduced effective study strategies, including "practice testing," and highlighted AskUp as one way to employ this technique.

When students logged into AskUp, they were invited to generate open-ended question and answer sets. To promote the generation of thoughtful questions, we provided students with a list of question stems that elicit higher levels of Bloom's taxonomy, as used in prior studies (King 1992) (Figure 1). When answering questions, students were shown the question and a place for reply with an open-ended answer. Students rated their own answers, indicating whether they answered the question correctly (Figure 2).

The number of users who used the app and the number and types of questions created were analyzed. This study was deemed exempt by the BIDMC Institutional Review Board.

| Technique | Utility |
|-------------------------------|----------|
| Practice testing | High |
| Distributed practice | High |
| Interleaved practice | Moderate |
| Elaborative interrogation | Moderate |
| Self-explanation | Moderate |
| Summarization | Low |
| Highlighting | Low |
| The keyword mnemonic | Low |
| Imagery use for text learning | Low |
| Rereading | Low |

TABLE 1. Effectiveness of various study techniques. Adapted from Dunlosky 2013

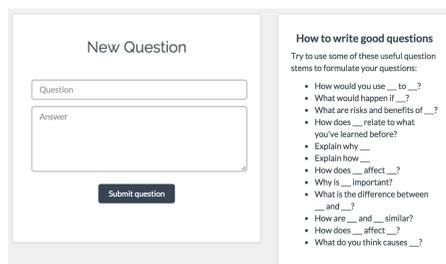


Figure 1. Generating questions within AskUp with the list of question stems that appears.

| Reason | # of users |
|------------------------------------|------------|
| No time/overwhelmed with resources | 42 |
| Did not remember/could not access | 14 |
| Not useful | 13 |
| Not needed | 12 |

TABLE 2. Student reasons why they did not use or log into the app.

| Application | # of users |
|--------------|------------|
| AskUp | 4 |
| Firecracker | 3 |
| Notability | 3 |
| Khan Academy | 2 |
| Prest | 2 |
| Quizlet | 1 |
| AskUp | 1 |

TABLE 3. Student use of educational apps to study for their exams.

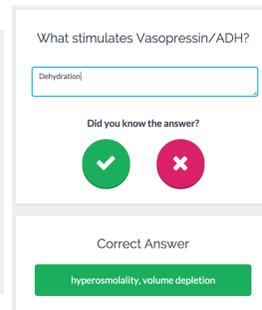


Figure 2. Answering questions, with the ability to self-rate whether the answer was correct

| |
|---|
| Questions created by professors |
| Overview of the questions by professors |
| Ability to flag incorrect questions |
| Links to relevant material from lecture notes/textbook/videos |
| Tagging question categories |
| Allowing different types of questions (multiple choice, true/false, matching) |
| Rating questions |
| Batch uploading of question and answer sets |
| View percentage of answers correct/incorrect |
| Ability to add pictures |
| Ability to edit questions and answers |
| Spaced repetition |
| Mobile application |

TABLE 4. Student questions for future version of the application

| Question | Never | Rarely | Sometimes | Often | All of the Time | Mean |
|---|-------|--------|-----------|-------|-----------------|------|
| Generating explanations in your mind about why a concept is true | 0% | 1.7% | 26.7% | 40.8% | 30.8% | 4 |
| Spreading out studying for the exam over time (as opposed to cramming) | 1.7% | 10.1% | 24.4% | 26.9% | 37% | 3.9 |
| Attempting to form mental images while reading or listening (visualizing in your mind how the heart pumps blood through the chambers) | 4.2% | 5.9% | 22.7% | 38.7% | 28.6% | 3.8 |
| Reviewing your class notes | 5% | 10.8% | 30% | 32.5% | 21.7% | 3.6 |
| Studying with other students | 0% | 3.3% | 46.7% | 37.5% | 12.5% | 3.6 |
| Taking practice tests or answering questions | 2.5% | 9.2% | 36.7% | 31.7% | 20% | 3.6 |
| Explaining to yourself how new information relates to prior knowledge | 2.5% | 12.6% | 32.8% | 37% | 15.1% | 3.5 |
| Re-reading material (after an initial reading) | 5% | 9.2% | 34.2% | 33.3% | 18.3% | 3.5 |
| Highlighting or underlining | 10.9% | 16% | 21.8% | 21.8% | 29.4% | 3.4 |
| Using concept maps | 4.2% | 15.8% | 30.8% | 34.2% | 15% | 3.4 |
| Writing your own summaries of course materials (books, lectures, etc) | 13.3% | 16.7% | 24.2% | 20.8% | 25% | 3.3 |
| Mixing different kinds of problems or topics within a single study session | 6.7% | 17.5% | 45.8% | 23.3% | 6.7% | 3.1 |
| Associating concepts with mental imagery (eg, picturing a homunculus to remember which parts of the brain innervate certain body parts) | 21.7% | 20.8% | 22.5% | 26.7% | 8.9% | 2.8 |
| Creating your own questions and answering them (e.g. flashcards) | 47.5% | 26.7% | 18.3% | 5.8% | 1.7% | 1.9 |
| Reviewing another student's notes | 43.3% | 36.7% | 17.5% | 1.7% | 0.8% | 1.8 |

Students were asked how often they used these strategies to study for their physiology exam. Colors correspond to Dunlosky's measure of effectiveness: green=high, yellow/moderate, red=low.

Results

26 students registered to use AskUp, most (71%) of them logged in only once. When asked why students did not access or log onto the website, student responses are seen in TABLE 3.

48 questions were created by registered students, of which 38 (79%) had answers provided by question-writers. Of the questions created, most questions began with "What" (65%), followed by "Describe" (15%), "Why" (10%), "How" (6%), "Where" (2%), and "Explain" (2%).

A minority of students (13%) reported using educational apps to study for their exams, these are listed in TABLE 4. When asked whether students would want to use an app to create their own question and answer sets based on class material and then share these anonymously with classmates, 21 (20%) answered Yes, 43 (41%) answered Maybe, and 41 (39%) answered No.

Students were asked whether they would be interested in learning more about evidence-based study strategies, 47 (45%) said Yes, 47 (45%) said Maybe, and 10 (10%) said No. Students who answered Yes or Maybe were then asked to rank how they would like to learn more about these strategies; the most popular response was an online live webinar, followed by an online module.

Some of the features that students wanted to include in future versions of the app are shown in TABLE 5.

Discussion

Medical students use a variety of study strategies in preparing for their exams. Answering questions or taking practice tests was a popular method, but its equally effective counterpart, creating and answering your own questions, was among the least popular study methods in this medical student group. A brief intervention explaining the benefits of question-generation and introduction of a web app was not effective in changing student study habits.

Students noted that creating their own question and answer sets takes "too much time." One prior study also noted that generating question and answers took longer than simply answering questions, yet provided a similar benefit, at least in the short term (Weinstein 2010). It is yet unknown whether learner-generated questions leads to greater learning in the long term, since, in addition to retrieval practice, question-generation employs elaboration, an important technique that improves encoding of information in the brain (Craig 1975). In addition, the use of learner-generated questions may be especially beneficial when there are no questions available.

Students also commented that they had already developed their own way of studying, and were hesitant to change. Previous studies have shown that learning styles seem to remain fairly stable throughout medical school (McManus 1998). Unfortunately, prior studies show that students may not be accurate judges of study efficacy, as they erroneously predict that "repeated studying" will be more effective than retrieval practice, even though the opposite is true (Karpicke 2011). Nevertheless, most had an interest in learning evidence-based study strategies.

Although students were provided with question stems based on higher levels of Bloom's taxonomy, they did not seem to use this approach. Previous studies suggest that the use of question stems such as these, they are more likely to ask higher ordered questions, and have greater recall that students who were not provided question stems (King 1992).

Prior studies have also indicated that sharing questions (asking and answering classmates questions) provides further benefit for students (King 1992).

Retrieval practice has been shown to be one of the most powerful methods of learning. For example, in a study comparing the efficacy of creating concept maps, an active learning approach that uses elaborative study tasks, with retrieval practice, retrieval practice was shown to be superior (Karpicke 2011).

Future Directions

Future studies should be done to see if teaching students to ask questions will make them better able to use this technique. Teaching students evidence-based study techniques early in medical school. Randomized study to evaluate whether this technique is effective in medical school and graduate medical education. Update the application based on student recommendations. Use question-generation as a method to spark curiosity and investigation in medicine.

Sponsors

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