Generalizable Education Research

Understanding factors affecting participation in online formative quizzes: an interview study

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MANY STUDIES HAVE documented a positive correlation between student performance on formative online quizzes and subsequent high-stakes summative assessments (e.g., Refs. 5, 9, 15–17, 19, 26). From a theoretical perspective, this is to be expected. Early behavioral and social cognitive learning theory introduced the idea that corrective feedback during the learning process should promote improved performance in a desired trait (14, 27) and showed that providing feedback on progress toward learning goals increases performance (3). In these broadly accepted traditional views, formative assessment provides information to identify gaps between current and desired performance, which a learner may then strive to narrow to maximize performance (22). More recently, a “testing effect” has also been described in which active retrieval of material through practice quizzing directly promotes the formation of long-term memory (21). Therefore, it is expected that participation in formative assessment has a positive effect on learning. From a programmatic perspective, we have moved beyond questioning whether formative assessments should be included, to addressing how to maximize their effectiveness.

Closely inspection of studies investigating the relationship between formative and summative testing shows that, irrespective of student performance, voluntary engagement in quizzes is also positively correlated with summative assessment outcomes (1, 16, 17). The data are consistent with self-regulated learning (SRL) theory, which characterizes the expert learner as one with high levels of intrinsic motivation and self-efficacy, who routinely engages in metacognitive regulation of effort and adapts learning strategy based on the outcomes of self-assessment (23). Voluntary participation in nonmandatory curricular activities is a good marker characterizing the ideal self-regulated learner (25). Whatever the explanation linking formative and summative testing outcomes, it is clear that participation and performance on formative assessment is a good prognostic indicator of success (16). More perplexing is why significant numbers of highly intelligent students in undergraduate and professional school fail to make good decisions about use of formative assessment; most often students believe that rereading is a better review strategy than quizzing (13). Equally surprising is the lack of literature to explain, from a student perspective, how they are making decisions about formative quiz use, and what barriers to engagement may be present. The goal of this interview study was to identify factors influencing medical student decisions about how to use optional formative assessments. The study follows from our earlier report confirming typical correlations between weekly online formative quiz use and summative assessment outcomes in the preclerkship phase of our Doctor of Medicine (MD) program (17).

METHODS

Research design. Since we were investigating a human behavior in a real-world context, we elected to use a grounded theory approach (6, 8). This method does not begin with a null hypothesis, but rather seeks to construct analytic codes and categories from records of lived experience, working toward a theory or model to explain observed phenomena. Sampling is not aimed at population representation, but rather proceeds to support theory construction. Data acquisition and analysis occur concurrently, and the interview script can change as the topics are explored more deeply. Data collection is completed when no new themes are emerging from analysis of the most recent interviews. The research team included a preclerkship medical student (AA) who recruited participants and conducted the primary coding analysis of de-identified interview transcripts, a senior student (SA) who conducted the confidential interviews, and a faculty member (JK) who audited the primary coding and worked collaboratively with AA to reach consensus on major themes and development of a model to explain barriers to quiz participation.

Participants and educational context. The University of Central Florida (UCF) College of Medicine offers an integrated 4-yr MD program. During the first year, foundational basic sciences are taught in Human Body modules that take advantage of traditional synergies between disciplines (e.g., physiology is taught together with anatomy,
immunology is taught with microbiology, etc.). In the second year, the focus shifts to the study of disease process through modules organized by body system (S-modules), and the preclerkship phase culminates with the requirement of students to pass the United States Medical Licensing Exam (USMLE) Step 1. The last phase of the curriculum is translation of knowledge and skills into practice and is represented by clerkship and elective rotations in the third and fourth academic years. A wide variety of teaching methods are used, including lectures, web-based self-learning modules, case-based learning, team-based learning, high-fidelity simulations, ultrasound laboratories, and use of standardized patients. Participants for this study included first- and second-year medical students who were recruited over a 1-yr period after completion of at least one semester of the MD program. Weekly online quizzes were provided throughout the first 2 yr. Each quiz was released on a Friday afternoon, and students were strongly recommended to take the quiz over the weekend. Correct answers were provided for each quiz, but additional elaborative feedback explaining right or wrong answer choices was not included in most cases. The quizzes were closed on Monday morning to allow faculty to gauge class performance and to go over in class any items that students had found difficult. The quiz was then added to an archive that students could access again at any time for regular study and review before the final module examination. No credit was given for taking quizzes in any module. This study was reviewed and exempted by the UCF Institutional Review Board. Students gave informed consent for de-identified interviews to be transcribed and coded for thematic analysis.

Sampling strategy. A particular difficulty with this kind of study is attracting participants, when the ideal target group is students who do not voluntarily participate in class activities. However, on close inspection of quantitative data from the previous cohort of students, we observed that the majority of students varied their behavior over time with respect to taking online quizzes. When presented with a quiz to take over a weekend, we found that ~70% of a cohort consistently attempted the quiz, but the individual students were different each time. When comparing two blocks of six weekly quizzes on either side of a midterm examination, we noted that >75% of students changed their quiz-taking pattern, with some students increasing and others decreasing their quiz use (17). Since most students have experience of electing both to take and not to take quizzes, we determined that a convenience sample was highly likely to include students able to discuss times when they chose not to take quizzes.

When consenting students into the project, we intentionally decided not to collect their personal quiz use or assessment scores to avoid adding disincentives to participation for students who may have negative emotions about quizzing or concerns for privacy. In an effort not to bias participant recruitment, the informed consent was phrased in a neutral way: “You will participate in an interview where you will be asked to describe how you have approached studying in medical school, how you have used end of week online quizzes, and what things you have or have not found useful about the online quizzes.” The informed consent was read in class by AA, and a follow-up recruitment email was sent from our College Assessment Office. The email contained a short optional demographic survey asking for sex, highest degree, type of first degree (science or nonscience major), and self-reported current average grade. The participants received a random alphanumeric code to be used when signing up for interviews to ensure confidentiality from the researchers analyzing the data. An online sign up was used for participants to select a time to meet with the interviewer; students received a $20 incentive payment for completing a 1-h interview.

Data collection and analysis. Interviews were semistructured following the guide in Table 1. The interviewer began with the high-level general questions and then had the latitude to ask for clarification or more information, using open-ended prompts. The second more detailed level of items shown in Table 1 were used when participants were reticent and did not spontaneously discuss these aspects of the topic. A digital recorder was used to capture audio from the interview, and the recording was transcribed verbatim. Coding proceeded in two general phases. The first phase of line-by-line coding sought to deconstruct the data, paraphrasing participant responses to extract ideas that could be compared within and between transcripts, as well as with interviewer field notes. Once this primary coding was completed, a second round of focused coding was undertaken to reconstruct the identified categories into themes and finally to propose a model showing how these themes may combine to explain nonparticipation in quizzes.

AA and JK started by independently coding the first three interview transcripts and then met to compare coding, to reach consensus on emerging category areas, and to assess whether the interview script needed modification to address study goals. As a result of this initial coding, the interview script was modified to add the more directed follow-up questions shown in Table 1 in an effort to ensure that rich

Table 1. Interview guide

<table>
<thead>
<tr>
<th>Interview Topic</th>
<th>High-level Questions</th>
<th>Possible Follow-up Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapport-building questions</td>
<td>1. How are you doing today?</td>
<td>a. Tell me about how you study for class.</td>
</tr>
<tr>
<td></td>
<td>2. How is school going?</td>
<td>b. Tell me about how you study for a test.</td>
</tr>
<tr>
<td></td>
<td>3. What parts of the curriculum are your favorites?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. What parts of school give you the most trouble?</td>
<td></td>
</tr>
<tr>
<td>Quiz-related questions</td>
<td>1. Tell me about your experiences with the end-of-week (EOW) quizzes.</td>
<td>a. What are some of the most helpful things about the EOW quizzes?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. What are some of the least helpful things about the EOW quizzes?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. How was the quality of the feedback from the EOW quizzes?</td>
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<td></td>
<td></td>
<td>d. What do you think the purpose of the EOW quizzes is?</td>
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<tr>
<td></td>
<td></td>
<td>e. How have the quizzes made you feel about your progress in the class?</td>
</tr>
<tr>
<td>Response questions</td>
<td>1. What kind of feedback have you received throughout your time at school?</td>
<td>a. Why was it useful?</td>
</tr>
<tr>
<td></td>
<td>2. What was the most useful type of feedback to you?</td>
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<td></td>
<td>3. How do you respond to this feedback if it is negative?</td>
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<td></td>
<td>4. How does your grade on a quiz affect how you study?</td>
<td></td>
</tr>
<tr>
<td>Closure</td>
<td>1. How do you feel about our discussion today?</td>
<td>a. Has this helped you to reflect on your approach to learning?</td>
</tr>
<tr>
<td></td>
<td>2. Do you think you will continue to reflect on these topics going forward?</td>
<td></td>
</tr>
</tbody>
</table>

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information about the end-of-week quizzes was elicited from every
subject. SA then proceeded to conduct interviews, which were coded
by AA until no new categories were emerging. A decision to stop
interviewing was made after 16 subjects, since saturation of themes
had occurred. JK then audited all of the primary coding and met with
AA to reach consensus on the major themes. All individual quotes that
are provided as examples in the RESULTS section are reproduced
verbatim.

RESULTS

The self-reported demographics of the sample indicated that
there were 8 female and 8 male participants; 5 out of 16
students had prior graduate level education; 10 students were
science majors, 4 were nonscience majors, and 2 had double
majors, including science and nonscience disciplines; and 8
students described themselves as “A” students and 8 as “B”
students. Our assertion that a convenience sample would in-
clude a substantial fraction of students with some experience
not taking voluntary weekly quizzes on time was born out: in
different sections of the interview, 14 of 16 participants dis-
cussed how time constraints had sometimes affected their
ability to take quizzes, and 9 of 16 recalled times when a
concurrent research course had conflicted with taking quizzes.
Only one subject was definitive about always taking quizzes on
time, whereas 11 out of 16 described usually taking them on
time, whereas 11 of 16 described usually taking them on
time. We did not have any participants who self-reported never
or rarely taking quizzes on time, but the apparent distribution
of behaviors was broadly consistent with the patterns we
expected based on prior quantitative study in our school (17)
and indeed provided a rich narrative about barriers to quiz use.
Focused coding produced a final model with four major themes
impacting a student’s decision about whether to take quizzes
on time: 1) inadequate feedback, 2) curriculum organization
and mistrust, 3) time constraints, and 4) fear of judgment.
The resulting model is shown in Fig. 1, and the synthesis that led to
it is discussed below.

Inadequate feedback. At the time the data were collected for
this study, most quizzes provided only correct answers without
elaborated feedback statements explaining correct and incor-
rect answers. Several courses attempted to discuss quiz items
in class on Monday morning if large numbers of students had
answered something incorrectly, suggesting a general miscon-
ception. Inadequate feedback was the most prevalent topic in
student narratives, with 15 out of 16 participants discussing it
and expressing the desire for some kind of elaborated feed-
back. Although some students could identify deficits in their
knowledge, it was not always apparent to the student exactly
what the deficit was, resulting in a strong desire for explanatory
feedback to direct their studies. For example:

“And then rather than just getting what the right answer is,
it would be nice to have some short one line about why that
was the right answer. Because sometimes it’s very difficult
even with the resources, etc. to know, okay, well, I understand
now why that the right answer but why is B not also right,
because you know, B seems like it would be right. So just like
a one-liner explanation would be nice.”

“... It would be very beneficial if we actually went over it
and knowing, not just okay, well, you got this. ...”

“Uh, it would be cool if there was feedback in the questions
themselves, like this answer choice is correct. It is correct
because such and such and such and such. If you put this, it’s
wrong because such and such, that type of thing.”

In some cases the lack of elaborated feedback was more than
an inconvenience and became a source of stress:

“Um, for the other stuff, generally the sooner the better, I
think. I . . . I . . . if I don’t feel like I did well, I kind of freak out
and need to know, you know?”

Or another student reflecting on the work needed to mine an
overload of resources to research incorrect quiz answers de-
dscribed his dilemma:

“It’s like a big wall of [expletive redacted] to do and I don’t
know where to start chiseling, you know?”

The need for better feedback is underlined, not just in terms
of streamlining the learning of knowledge, but also to give
students a clearer sense of how they stand in terms of effec-
tiveness of their studying. Students were often strongly im-
pacted by quiz outcome, in terms of both their subsequent
effort regulation and sense of well being:

“If I do really poorly, I’m more apt to, okay, I’m not going
out tonight, I need to sit down and focus. If I do really well, I
give myself, backing off.”

“Sometimes like its—sometimes you can kind of get some
discouraged, especially when it like over and over again
and still studying and still getting everything wrong. Its like, I’m
not sure what . . . like it’s sometimes it does give some sense of
despair and like hopeless. Otherwise, you know, I try to brush
that of and keep on.”

“What do I do for the rest of the module? Uh, procrastinate
and try not to think about school!”

Participants were uniformly rooted in the notion that the
function of quizzes was purely for self-evaluation (15 out of 16
interviewees), and no students recognized quizzes as a means
for retrieval practice or enhanced learning during the primary
studying phase. Several students stated that they needed to
“fully review the content” before taking any assessment. De-
spite the lack of any course credit, it seems that quizzes are
“high stakes” for many students in terms of implicit feedback
about how effective they seem to be more generally, which is
discussed further under the theme of fear of judgment. It is
clear that feedback on quizzes is critical, both in terms of the
specific content but also answering the underlying student
question “How am I doing?”

Curriculum organization and mistrust. We had initially
identified factors under curriculum organization and mistrust as
separate themes but decided to combine them, since misalign-
ment between formal curriculum and quizzes was a major source of mistrust. Common issues included the strong negative impact of occasional miskeyed items:

“Sometimes they have wrong answers, and if I would take—it happened a couple of times where it had the wrong answers and I would take the quiz on Friday and would spaz out over the weekend and could not figure something out. It was really bad.”

“...The thing that’s disheartening about it is sometimes I hear, you’ll get a question wrong and then a faculty member will say, oh well, that kind of got tossed in there and don’t worry about it for the exam. That’s really disheartening...”

Several students noted that the lack of elaborated explanations compounded the problem of miskeyed items, since they would be able to determine that a miskey had occurred by working through the explanation statements.

Another common source of frustration was any perceived misalignment between the topics taught with those tested:

“...So no one knew what the heck that question was, and no one could find it in their notes, and no one even knew about it, and it turns out that it was just straight out of Robins, so that got kind of frustrating.”

“Just like I said before, how sometimes there was a disconnect between the quiz questions and the test questions where I felt like I really did know a concept, but then it didn’t show on the test because maybe...maybe the quiz was really focused on this one lecture, but the test was really focused on a completely different lecture.”

From a faculty perspective, the frequency of keying errors or examples where a question was placed on the wrong quiz were rare. However, such instances clearly had a strong negative impact on the perception of quizzes as they were recounted by several students in the sample. Again, there is ample evidence here that powerful implicit messages are sent to students through the quality and content of formative quizzes:

“Um, the quiz...the quiz is my way of telling whether or not I’ve done a decent job that week at trying to pay attention and get things to be intuitive and stick. Um, if something...if there’s something that I just don’t recognize at all, it freaks me out.”

Another yardstick students are using to judge the value of quizzes, and indeed the rest of the formal curriculum, is the perception of whether quizzes directly prepare them for the USMLE Step 1 exam:

“What I think the goal of everything we do here is to prepare us for our stuff on boards, because that, grades are important, but the true number that matters is how you do on that exam, so I think every kind of question I hear should mirror the questions that are on those board exams.”

Other issues related to the impact of overall curriculum organization on quiz usage included the combined workload at a particular time, such as when a research deadline or clinical skills course assessment overlapped with quiz preparation.

Time constraints. Of the 16 students interviewed, 14 reported that time constraints had affected their ability to take formative assessments at some point in time. Continuing the theme from the preceding discussion of curriculum organization, a common complaint was conflicts with other parts of the MD curriculum; most notably the required research projects [Focused Individualized Research Experience (FIRE)], as well as clinical preceptorships:

“I am going to VA so we are doing the VA training for a couple of hours and then doing like FIRE and stuff and by the time—I can’t study at night.”

“...FIRE is kicking in and our, excuse me, practice [preceptorship] is kicking in, and it’s messing up the schedule which if you mess with the schedule that messes with the time and whether you mean for it to or not, it really messes with how you study.”

In talking more generally about their time constraints, students included time spent with spouses and children, with their parents, time to exercise, to look after pets, and obligatory travel. Our interview sample included nontraditional students who felt these constraints most keenly:

“Well, I mean, I’m married. I have dogs. So I call them life responsibilities. ...So you know, something to balance home and school life. There’s a lot more, I have more potential study time for sure, but, I mean, I’m going to sacrifice a few points on the exam. And I actually have all these right now and I’m going to sacrifice a few points on the exam to spend more time with my wife, and my dogs too.”

As a sidebar, these students did not feel supported when discussing time-management strategies with academic counselors:

“Let me reiterate that I feel like I got scared. Our first meeting was in July when she talked about how to study and how to organize your time...I was like, ‘This is not...It’s just not me.’ Like there’s no way, so you know, like what if you’re a nontraditional student and you have other responsibilities? How do you incorporate your responsibilities with the studying type of thing?”

“But because not every person has the same lifestyle outside of school, so we can’t all go home and study for 5 hours.”

Fear of judgment. When electing to systematically provide quizzes across the whole curriculum, the faculty emphasized that no summative credit would be attached to quiz outcomes in an effort to create a low-pressure culture that would promote nonjudgmental self-assessment. Despite this attempt at a supportive learning environment, 9 out of 16 interviewees indicated some level of fear attached to taking formative assessments. In many cases, fear was centered on the judgment of self and the risk of confirmatory messages, which would be interpreted as indicating low ability, with the subsequent effect of decreasing motivation:

“Sometimes I got kind of scared to take them because I knew I would do bad, and so I would be not afraid, but I say I don’t want to get there and take that and know that I only know 50% of the material and then I really did, you know, and half of that is probably guessing, so, be more concerned, I would be worried about concerning myself with not knowing the material, which is probably not very good.”

“...There were just some concepts that I was completely lost on, and so I didn’t want to take the quiz and make a 30 and know that I didn’t know anything and then just be more confused...”

“It makes me not want to study.”

“It makes me realize where I am. What am I doing wrong? It’s like, okay, I keep studying. It’s just discouraging to see that low grade.”

“...When I get a good grade, I feel like I want to study more but a bad grade can, in fact, make me want to study less.”

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On occasions where faculty attempted to debrief the whole class on a Monday morning on items that many students had found difficult, there was also strong reluctance to reveal being wrong in front of peers and faculty:

“... and then they’ll say, ‘oh, do you have any questions about that?’ And then the class will be, you know, silent, and then they move right on, even though like technically, I did have a question but I know I can’t just hold up the whole class.”

“Clearly we didn’t get it, and they would read the question and then read the answer, and then say, ‘oh, does anyone have any questions?’ And it’s like, clearly we had questions. We got it wrong. Like you want us to raise our hands in front of 100 of our smartest peers and [say], ‘I’m an idiot. I missed that,’ you know.”

DISCUSSION

The goal of this interview study was to identify factors influencing a medical student’s decision about whether to use formative assessments. We identified four major interacting factors that we postulate as the main drivers limiting quiz use: 1) inadequate feedback, 2) curriculum misalignment and mistrust, 3) time constraints, and 4) fear of judgment. A limitation of the study was our inability to sample directly from the very small population of medical students who rarely or never take formative quizzes. However, we were able to develop a model explaining major factors that underlie the on-off pattern of quiz use seen in most students. While the model may not explain the more extreme noncompliance of a few students, it throws light on major factors that may inhibit quiz use and offers faculty some practice points for improvement.

Participation in online formative quizzes falls directly under the rubric of SRL theory (7, 23). At its core, SRL involves flexible cycles of planning, action, and feedback in which learners ideally set goals, decide on strategies, seek and obtain feedback, and adjust learning strategies as needed to meet goals (4). In the context of SRL, online quizzes provide the ongoing feedback function to help learners modify their learning behaviors. For example, learners can respond to feedback by varying their time management, regulating effort level, and deciding what nonmandatory activities in which to engage. In the SRL model, failing to take online quizzes not only deprives the learner of needed feedback to complete a cycle of SRL, but is itself a manifestation of a poor learning strategy. Prior research has highlighted the importance of student characteristics, such self-efficacy (belief they will succeed), to sustain effort and motivation through challenging periods (7); students will also vary in their metacognitive ability to attribute cause and effect and adapt their approaches to study.

The most prevalent complaint of students in our sample was inadequate feedback, a factor that is directly amenable to faculty intervention. As a result of these findings, our faculty is currently engaged in the large task of providing elaborated written feedback for every quiz item presented to students. In the absence of clear evidence about what kind of feedback is likely to enhance later performance, our approach at present is to provide one or two concise sentences indicating why answers are right or wrong, and sometimes to refer students back to particular lessons for more detailed explanations. While serving the basic requirement for an SRL cycle, it is unlikely that this information alone will constitute optimal feedback.

Nicol and Macfarlane-Dick (18) describe seven principles of good feedback to support SRL, which go beyond providing content-based explanations. For example, clarifying the meaning of good performance is necessary. Our interview narratives included concern that students did not know what a “good” or “bad” quiz score is, which weakens the basic SRL cycle of metacognitive reflection about how successful current study strategies are. Students usually score around 20% lower the first time they take a quiz than they will on the final summative exam. We have, therefore, started to share class averages each week to give better context for each student to interpret their score. Other desirable aspects of feedback include efforts to encourage motivation and self-esteem and to promote dialogue with peers and teachers. For example, in a prior study, JK was able to consistently achieve quiz participation rates of 90% in a premedical class by targeting these areas (16). Optimization of feedback is a complex topic, including issues such as timing; delivery of positive or negative feedback; whether to focus on task, process, or person; how progress relates to goals; etc. (12). Feedback should also be personalized and incorporated into study skills advising when helping struggling students to engage in SRL cycles of reflection and action.

The second theme identified in this study was curriculum organization and mistrust that was generated by errors in quizzes or when there was misalignment of curriculum and quiz content. An informal review suggested that quizzes were generally of high quality in terms of item format, representative difficulty level, and mapping to curriculum content. Therefore, it seems that a small number of errors can produce a large negative effect in students. Keying errors were compounded by the lack of elaborated feedback, which left students with a lot of work to do to resolve correct answers on their own. In a new medical school our curriculum is constantly evolving, which has led to instances of items being left on a quiz when teaching sequences have changed. We also have an integrated curriculum design, so that the concepts in a given question may reflect teaching from more than one session or faculty member, making precise alignment more difficult. Irrespective of the reasons for the phenomenon, it has a marked negative effect on student trust in the formative assessment process and is a disincentive to participation. One student even extrapolated from the presence of quiz errors to question whether any faculty-generated material could be fully trusted.

The issue of mistrust is concerning and warrants further consideration. Based on studies of organization and management, the development of trust requires three basic characteristics of the mentor: ability, benevolence, and integrity (20, 24). The presence of quiz errors appears to cause faculty to fall at the first hurdle of confirming their basic ability. Trust evolves in stages, the first being deterrence-based trust in which the truster will listen for fear of doing the wrong thing. The next stage is knowledge-based trust in which the truster can adequately predict the mentor, assuming their relationship to date has been beneficial. Eventually there can be identification-based trust in which the mentor-mentee goals are clearly in alignment; identification-based trust is considered the strongest and most influential form of trust (10). Generation of trust is difficult for many medical school faculty who may have limited face-to-face time with students and thus lack opportunity to build foundations of trust. Students appear to take strong implicit messages from formative quizzes about faculty
competence and perhaps also how committed to student success they are, based on the apparent effort put forth to produce an excellent quiz. Viewed in this light, quiz development deserves special effort to ensure high quality.

Another major theme affecting quiz use, and perhaps the most predictable, was time constraints on students. This partly overlaps with curriculum organization issues, since there were times when students described conflicts within the formal curriculum. In our curriculum, there is typically one basic science module running at a given time with a concurrent year-long course in clinical skills, plus a mandatory research project. The latter in particular created time conflicts when required deadlines took precedence over voluntary quizzes. However, this theme also captured issues related to personal time management and deciding what learning activities to prioritize. This intersects again with SRL and the topic of optimal resource management (23). Recent work on retrieval-based learning shows that students will more often relegate quizzing in favor of other less effective study strategies (13). There is a pervasive misconception that quizzing is low priority, which needs to be addressed with a concerted effort by faculty as well as study-skills advisors. Part of the problem comes back to the damaging psychological effect that receiving a low quiz score has on some students. Our data revealed several examples where students did not want to experience the negative feelings caused by a low quiz score. Artino et al. (2) used a framework of achievement goal structures to identify that lower performing students tend to have a “performance-avoidance” approach that prioritizes avoiding demonstrations of incompetence and is associated with maladaptive learning behaviors, such as procrastination and avoidance of help seeking. Avoiding online quizzes fits into this behavior pattern, and our narratives suggest that there is significant risk of a vicious cycle of test anxiety, poor quiz scores, lowered self-efficacy, decreased motivation, and disengagement for some students. This picture intersects strongly with our final theme of fear of incompetence and is associated with maladaptive learning behaviors, such as procrastination and avoidance of help seeking.

Avoiding online quizzes fits into this behavior pattern, and our narratives suggest that there is significant risk of a vicious cycle of test anxiety, poor quiz scores, lowered self-efficacy, decreased motivation, and disengagement for some students. This picture intersects strongly with our final theme of fear of incompetence and is associated with maladaptive learning behaviors, such as procrastination and avoidance of help seeking. Avoiding online quizzes fits into this behavior pattern, and our narratives suggest that there is significant risk of a vicious cycle of test anxiety, poor quiz scores, lowered self-efficacy, decreased motivation, and disengagement for some students. This picture intersects strongly with our final theme of fear of incompetence and is associated with maladaptive learning behaviors, such as procrastination and avoidance of help seeking.

A final synthesis suggests that, in addition to the four major explicit themes emerging from our data, there are overtones of implicit or hidden curriculum. The hidden curriculum refers to what kinds of ideology, values, and behaviors students learn outside of the formal curriculum through being immersed in institutional culture (11). It appeared from the data that online quizzes operate as a megaphone for implicit messages that are being heard by students, even though faculty may not intend to send them. The quizzes seem to be ironically high stakes (considering they do not count for grade) in the sense that personal well being seems to be under threat if a score is bad, harsh judgments are being made about faculty competence when mistakes are found, and hidden meaning is being read into what is important to learn based on what questions are asked. More concerning are isolated comments that suggest our learning culture is perceived as negative toward low performers, as some students seek to avoid embarrassing themselves by admitting they got a question wrong. On the flip side, this also gives faculty a great opportunity to support learning outcomes through online quizzes via both the formal and implicit curriculum, by adopting the following practice points:

1. At the start of a course or class, discuss the intended role of online quizzes in learning, both as a tool for retrieval practice and as a tool for SRL.
2. Clearly state expectations about performance (e.g., some items might be included as simple mastery level items, others might be fully representative of summative assessment). Promote the idea of improvement over performance level to lower stress in the learning environment. Encourage participation and persistence, and welcome feedback about the quizzes.
3. Monitor overall curriculum workload and modify quiz schedule at busy times to ensure taking the quiz is feasible.
4. Provide students with options to help close performance gaps (e.g., welcome students into office hours, partner with peer-coaching program or study skills office to minimize misalignment with the informal curriculum and reinforce encouragement).
5. Ensure close alignment between stated learning objectives and quiz content; blueprint the material to show how all of the material is being fairly covered on formative and summative assessments.
6. Vet the questions with colleagues to avoid simple errors. Write items with the same care as for summative assessment.
7. Provide concise and immediate elaborated feedback on correct and incorrect answers.

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DISCLOSURES
No conflicts of interest, financial or otherwise, are declared by the author(s).

AUTHOR CONTRIBUTIONS
A.A. and J.D.K. conceived and designed research; A.A. and J.D.K. analyzed data; A.A. and J.D.K. interpreted results of experiments; A.A. and J.D.K. prepared figures; A.A. and J.D.K. drafted manuscript; A.A. and J.D.K. edited and revised manuscript; A.A., S.A., and J.D.K. approved final version of manuscript; S.A. performed experiments.

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