COMMENTARY

Making Students' Thinking Visible During Active Learning

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Active learning has grown in importance in pharmacy education over the years as seen with its emphasis in the previous and current Doctor of Pharmacy Program Accreditation Standards.[1,2] Searching the term "active learning" in the *American Journal of Pharmaceutical Education* resulted in 1,617 articles related to active learning techniques such as audience response systems, case-based teaching, and team-based learning.[3-7] Stewart and colleagues in 2011 reported that 87% of respondents from US colleges and schools of pharmacy use active learning techniques in their classroom.[8] This data,[8] which resulted from a survey with a response rate of 95%, suggests that faculty members have taken the first step and have selected and incorporated active learning techniques to increase students' engagement in the classroom.

However, guidance is needed to effectively implement and administer the active learning strategies[8,9] because the design and administration can impact how well students are engaged and what they learn from the activity. A 2015 *Journal* viewpoint offered useful suggestions for implementing active learning such as starting with simple activities, explaining the rationale and expectations of the activity to increase student participation, and stating the learning objectives for the activity.[9] These suggestions can minimize anxiety when implementing active learning into the classroom, but additional guidance is needed for *administering the activity and evaluating the outcomes*.

Overall, one of the most important things faculty members can do during the administration and evaluation process is ask "does the active learning strategy make students' thinking visible?" The visible thinking results from students talking, writing, or demonstrating a skill and it allows faculty to evaluate the thinking and ultimately the learning outcome. When active learning makes students' thinking visible, it allows faculty members to

reinforce or remediate concepts in the moment. This allows faculty members to provide valuable learning feedback and close the active learning loop. If a faculty member asks an open-ended question over a patient case as an active learning strategy and only one student responds or the faculty member offers the answer, students' thinking has not been made visible. In addition to asking if the active learning strategy is making the majority of students' thinking visible, additional guidance for active learning *administration* can be framed within the four core requirements for active learning: activating prior knowledge; involving the majority of students; promoting student metacognition including reflection; and providing students with feedback about their learning.[10]

First, the activity should actively engage students to connect their existing knowledge to the current knowledge presented in class, called activating prior knowledge.[10] When asking students to elicit what they already know, faculty members should also help students make connections between what they already know and what they are going to learn through the use of learning objectives.[10] While having students stand up and stretch at the beginning or during class gets them "active," the exercise does not meet this first criterion because it isn't asking students to activate their prior knowledge. It also does not prime them for what they are expected to learn. One active learning strategy that meets the criteria of activating students' prior knowledge is to give them a quiz (paper or electronically) before or at the beginning of class that covers prerequisite information related to the class content.

Second, the majority of students should participate in the meaningful activity.[10] For example, faculty members may ask their class to respond to an open-ended question, which is a common active learning strategy.[10] Many faculty members can recall lectures where one student answered all of the questions during a given class discussion. Although the faculty member may be relieved that at least one student is participating, it is not clear what the other students are thinking or learning. If one or two students respond to the question, a faculty member should reflect that the activity did not make the majority of students' thinking visible. Failure to ask this question could

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result in a faculty member overestimating the number of students that understood the concept in question. Sometimes a majority of students do not participate because a faculty member offers less than 10 seconds to answer a question, which is too short for students to process the question, think of and rehearse an answer, and raise their hand.[11] Simply increasing a question's wait time can increase participation. Some faculty members may believe that getting the majority of students to participate in the active learning is impossible for large class sizes.

However, one way faculty can engage the majority of students and make students' thinking visible is to use audience response system (clicker) questions. Clickers allow each student's response to a multiple-choice question to be aggregated and displayed to the class so students can visually see how their thinking is similar or different to their peers' thinking.[4] It also allows faculty to see if the majority understand a point or if further clarification is needed.[4] Faculty members should avoid offering the clicker question in close proximity to the lecture content they present because the close placement only tests immediate recall. Secondly, faculty members do not always ask students to explain their thinking after they have selected an answer and they miss another opportunity to make students' thinking visible. The lack of student discussion may result from questions that are too easy or from faculty explaining why the answer(s) are correct or incorrect, instead of the students. In either case, students' selection of the correct clicker answer does not guarantee that students know why the answer is correct or know the correct justification.

The third aspect faculty members should consider when administering active learning is to evaluate if the activity emphasizes metacognitive thinking so students can become more aware of their strengths and weaknesses as learners.[12] This metacognitive aspect of active learning asks students to intentionally monitor and evaluate their thinking and current level of mastery and understanding.[13,14] Making students' metacognition visible during active learning is helpful since students can be weak in this area. One way that faculty members could emphasize metacognition during active learning using formative test questions is to ask students to intentionally reflect on why they got a test question wrong even after they have studied and to make a plan to remediate their knowledge in the content area of the test question.[14-16] This metacognitive activity can help students actively monitor what they know and don't know and ultimately improve their learning outcomes and performance.[15]

The last area of guidance for faculty members administering and evaluating active learning is to ensure that students receive feedback about their learning.

Making students' thinking visible makes it easier to provide those students with feedback about their learning. Without this feedback, students may incorrectly assume they have understood the content. It is essential that a faculty member offer feedback to the students about their answers so students can understand the key take home points of the question.

One way faculty can provide feedback on active learning strategies is to use a rubric to offer faculty or peer feedback.[17] Rubrics can allow faculty members to make their expectations for active learning activities explicit and help students understand how well they achieved those learning expectations.

Another way that a faculty member can incorporate feedback into active learning is to use a think-pair-share (TPS) active learning strategy.[11,18] TPS activities follow the structure of asking the class a question, having students take a given amount of time to write down the answer, giving students a set amount of time to discuss their answer with their classmates and receive peer feedback, having student volunteers share their answers with the entire class and ending with the faculty member providing a summary and feedback about the responses.[11,18] TPS has several benefits because the active learning strategy involves the majority of students; allows students to reveal their thinking; provides students with peer feedback; and allows students to receive faculty feedback.

In summary, a growing number of pharmacy faculty members utilize active learning strategies in their classroom. Selecting and planning implementation of the strategy is the first step, but faculty members must also consider the administration and evaluation of the strategy to ensure that students are engaged in and learning from the activity. Every time faculty members use active learning in class, they should ask if they have made students' thinking visible. Faculty members should also evaluate if their active learning strategy activates prior knowledge, involves the majority of students, promotes student metacognition, and provides students with feedback. Oftentimes, faculty members' active learning strategy fails to meet one or more of these criteria, which negates the learning benefits and interferes with students becoming "active."

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