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12 tips for effective questioning in medical education

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ABSTRACT

Questioning is one of the most frequently used and powerful teaching strategies across levels and settings in medical education. Although the concept of asking questions may seem like a simple practice, many medical educators lack pedagogical training. When effectively executed, questioning can elicit positive outcomes in learner participation, concentration, and understanding of content. When used incorrectly, questioning can leave learners feeling singled out and not in a position to learn, or worse – threatened or humiliated. There is a lot of literature in medical education about what ineffective questioning looks like, but little about how to enact effective questioning, such as what kind of questions should be asked and how to design those questions to improve learning. The following twelve tips will help medical educators be purposeful and effective as they plan, ask, and analyze questions in classroom or clinical settings.

KEYWORDS

Methods; lectures/large group; clinical; general; small group teaching

Introduction

Asking questions is a common and necessary teaching practice for medical educators. We use the term medical educator to refer to anyone preparing future clinicians inclusive of all medical education settings (Branch et al. 1997). Questioning is rooted in the educational tradition of the philosopher Socrates (Neenan 2009; Kost and Chen 2015) and is powerful strategy educators use to scaffold learning and encourage the development of critical thinking skills (Smith 1977; Costa 1985; Garside 1996; Ritchhart et al. 2011). When effectively executed, questioning can elicit positive outcomes in learner participation, concentration, and understanding of content (Cho et al. 2012). Learners and medical educators alike believe questioning is useful to ‘promote learning, logical thinking, defending one’s decisions, quick recall, self-assessment, and communicating well with one’s peers’ (Kost and Chen 2015; Goebel et al. 2019). Questioning is also used by medical educators to assess understanding, clinical skills, and reasoning in order to promote learner progress toward independence in the clinical setting (Bowen 2006). Most agree that questioning is one of the primary educational activities in medical education (Amin and Khoo 2003; Lo and Regehr 2017). However, the literature on how to effectively use the questioning technique in medical education is limited.

There is significant literature about what ineffective questioning looks like (Detsky 2009; Kost and Chen 2015; Mavis et al. 2014; Stoddard and O’Dell 2016), but little about effective questioning, such as what kind of questions should be asked and how medical educators can prevent learner humiliation (Kost and Chen 2015). Although the concept of asking questions seems a simple practice, many medical educators lack formal pedagogical training. Often medical educators ask questions in the same way questions were asked of them when they were learners, which is not always the most

effective (Kost and Chen 2015). Additionally, many medical educators mistakenly assume questioning increases undue anxiety for learners (Amin and Khoo 2003). Not all questioning achieves the same results or prompts learners to the same level of thinking and response (Sachdeva 1996; Wink 1993). The following twelve tips will help medical educators be purposeful and effective as they plan, ask, and analyze questions in classroom or clinical settings.

Tip 1: Ask questions to scaffold learning

Questioning is most often thought of as a way to assess what learners know, and it is effective in doing so; however, questioning can also be used to scaffold learners toward understanding. Scaffolding refers to the support educators offer learners to help them accomplish goals that are beyond their capacity without the support of a more capable other (Van de Pol et al. 2010). Scaffolding is a dynamic process that requires the medical educator to be able to identify the knowledge gap faced by a learner, and then offer support for the learner as they move toward a more advanced understanding (Van de Pol et al. 2010). To do this well, the medical educator must have two ideas in mind: the learning objective, and the learner’s current level of knowledge. Once the medical educator has identified the starting and endpoints of learning they can design questions that serve as effective scaffolding. Asking questions to scaffold learning in the clinical setting is often done at the moment through a give and take between the learner and medical educator. Medical educators leading more formal class settings can use planning time to design great scaffolding questions. It is important for the medical educator to think through the following when designing questions:

- What do my learners already know about this topic?

- What do I want my learners to know about this topic when they leave today?
- What questions can I ask that will help learners think and fill in knowledge gaps?

The trick is to ask questions that help learners access what they do know and build from there with further questions as guides. For example, in the following segment the medical educator (ME) uses questions to scaffold the learner to understand how bacterial middle ear infections occur:

ME – These microbiotas are common in the respiratory tract so why doesn't everyone get an ear infection?

Learner – I don't know ...

ME – So think about it, why do we have a eustachian tube?

Learner – To drain the ear.

ME – Yes to drain the middle ear. But what happens to this space once the eustachian tube gets blocked with fluid and pathogens?

At the start of that discussion, the learner is unable to answer the question asked. However, the medical educator scaffolds thinking to support learning to this next level.

When scaffolding in the classroom setting, medical educators designing questions should ask themselves:

- Is the question merely engaging? Or will asking it lead toward the main learning objective? (Wiggins and Wilbur 2015)
- Does the question get at what's odd, counterintuitive, or easily misunderstood? Or is it a predictable question with mundane and relatively obvious answers? (Wiggins and Wilbur 2015)

When medical educators have a clear understanding of what learners know and what they need to know, they can ask questions to help learners bridge knowledge gaps.

Tip 2: Understand the roles of open and closed questions in learning

Understanding and utilizing different categories of questions allows the medical educator to purposefully target specific learning goals. One commonly used categorical distinction is that of open-ended and closed-ended questions. Open-ended questions allow for multiple ways of thinking about the question posed. Sometimes open-ended questions ask learners to synthesize and defend how or why they know something to be true (Webb 2009; Ritchhart et al. 2011). Closed-ended questions have a clear answer, often requiring learners to engage in the recall of facts (Webb 2009; Ritchhart et al. 2011). Medical educators should employ both question types in their teaching. Each serves a purpose and each potentially helps learners meet different objectives. For example, if the goal is for learners to read an electrocardiogram, the medical educator might ask the closed-ended question, 'What can you identify on this electrocardiogram?' In the closed-ended example, the learner needs to identify the parts of an electrocardiogram, an important first step in learning how to read an electrocardiogram. However, if learners are attempting to differentiate between emergent and non-emergent situations

based on an electrocardiogram, the medical educator might use an open-ended question such as, 'Looking at the electrocardiogram, do you think this patient is emergent, why or why not?' In the open-ended question, learners have to make a choice using evidence to explain their thinking. Another example of an open-ended question would be a question with no certain answer such as, 'Has anyone had an experience from the clinic that relates to this case ...?' Open-ended and close-ended questions can be further refined into additional levels, as explained in tip number three.

Tip 3: Use all levels of questioning

In an effort to push learners beyond simply recalling basic facts, questioning frameworks such as Bloom's Taxonomy (Krathwohl and Anderson 2009) were developed. Bloom's Taxonomy provides a structure for thinking about how learners develop knowledge of a concept moving from recalling basic facts towards the complex thinking needed to synthesize concepts (Webb et al. 2013). Connecting Bloom's Taxonomy with medical education, Barrett et al. (2017) researched questioning in graduate medical education surgical contexts according to Bloom's Taxonomy. The East Virginia Medical School (EVMS 2019) also used Bloom's Taxonomy to guide questioning in medical education. Table 1 combines all of their work in an adapted version.

In the table above, we provide examples of how questioning might shift as a medical educator adjusts the amount and type of scaffolding learners need to help move them through the levels of Bloom's Taxonomy. All levels of questions need to be asked at various times, and it is up to the educator to decide which level of questioning will best support learners in reaching the objective. However, as the learner becomes more knowledgeable and proficient, the questions should move toward higher-order thinking questions (Phillips and Duke 2001).

Tip 4: Ask questions as a model of clinical reasoning

Clinicians frequently ask questions of patients as they investigate symptoms and work toward a differential diagnosis. This learned skill begins in medical school by learning questions to ask oneself as a physician thinking through a case, or questions to ask the patient. Part of the role of a medical educator is to model professional behaviors and ways of thinking for medical learners (Rencic 2011). Clinicians engage in unique patterns of thinking, especially when diagnosing and treating a patient – often referred to as 'clinical reasoning' (Eva 2005). These patterns of thinking must be explicitly taught to and practiced by learners until the learners are able to internalize this type of thinking and practice it independently (Myrick and Yonge 2002; Sharp and Gallimore 1991). Questions can be used to support this process. When medical educators ask learners specific questions after seeing a patient case, they are often implicitly walking learners through their thinking. Additionally, questioning in this manner encourages learners to practice verbalizing what they know (Lo and Regehr 2017) However, when a medical educator makes their thinking explicit by thinking aloud, this can be especially beneficial for novice learners (Ritchhart et al. 2011). When a

Table 1. Levels of questions asked.

	←Lower order thinking			Higher order thinking→		
Revised Bloom's taxonomy level	Remembering	Understanding	Applying	Analyzing	Evaluating	Synthesizing & Creating
Descriptive anchors	Foundational principles; recall facts: identify; list; name	Understand results; follow guidelines; explain; interpret; illustrate	Concrete steps; apply; demonstrate; use	Organize meaningful patterns; analyze; compare and contrast; predict	Justify and defend decision; critique; judge	Construct; develop; propose; plan; manage; generate
Representative undergraduate medical education questions	What is a pulse pressure?	How do diuretics work?	What components of the physical exam might demonstrate abnormalities related to hypertension?	What are possible reasons for hypertension?	Why do you think so?	How would you manage ... ?
Representative graduate medical education questions (e.g. surgery)	See our landmark here? What is that called?	Where do you think we should put our camera port?	Why don't we take your hook cautery and open this spot here?	Where are you going to go after you clear that duct?	Why would you do that?	What is your plan for ... ?

*Adapted from Table 1 in Barrett et al. (2017) and EVMS (2019).

learner understands why the medical educator has chosen to ask that question, it allows the learners a window into the professional monologue of the clinician.

For example, a medical educator might ask learners after leaving the bedside of a patient experiencing difficulty breathing, 'should we order an X-ray?' In asking that question, the medical educator may be trying to scaffold learners' thinking by helping them hone in on what the learner should notice that would suggest an X-ray should be ordered. For an early first-year medical student, the medical educator might make their thinking process more evident by phrasing the question like, 'I noticed crackling in the left lower lung during the physical exam of our patient. This made me wonder if we should order an X-ray to better understand what was causing that sound. What do you think could be causing the sound?' In this example, rather than asking a question where the learner is asked to draw their conclusions, the medical educator is instead modeling their thinking and asking the learner to engage along with them in the process. Thus, the medical educator is using questioning to model and scaffold the development of clinical reasoning.

Tip 5: Probe, don't 'prod,' by creating psychological safety

Caution must be used when asking learners challenging questions that demand higher-order thinking. Medical learners who are probed with questions (i.e. direct questioning) often feel they are being 'pimped' instead of challenged (Lo and Regehr 2017). Like others, we take issue with the term 'pimping' and the gendered connotations it implies (Martin and Wells 2014; Nagarur et al. 2019). We will from here on refer to it as 'prodding' and we encourage the medical community to follow suit. Prodding implies the intent of the questioner to humiliate, cause discomfort, or malignantly illuminate knowledge gaps. The distinction between the genuine Socratic method and prodding is not always obvious since the essential transaction of both is an exchange in which the educator poses questions to learners (Goebel et al. 2019; Kost and Chen

2015). The differentiation between Socratic teaching and prodding lies in the intent of the questioner and the perception of the learner (Kost and Chen 2015; Stoddard and O'Dell 2016). If the educational environment is not conducive to learners recognizing Socratic teaching, then even a well-intentioned medical educator's probing questions may be perceived as prodding (Stoddard and O'Dell 2016). The most effective probing questions will occasionally exceed the bounds of learners' knowledge and may thus be perceived as prodding if psychological safety has not been established (Stoddard and O'Dell 2016).

Recommendations for creating psychological safety (Mavis et al. 2014; Stoddard and O'Dell 2016).

- Create an atmosphere of respect by explaining early on how they will probe, the reason for probing, and reminding learners of what probing will sound like.
- Ask questions are asked at an appropriate level for the learners.
- When probing, give sufficient time for answers by allowing silence or 'wait time' after posing questions, during which learners have the opportunity to consider the question, reflect on their knowledge, or think aloud.
- Allow learners to say 'I don't know' or ask for help from others.
- Prompt when learners 'don't know' to help learners voice what they do know and help them build connections to what is known.
- Use verbal and non-verbal communication to show support to learners while they are challenged (e.g. nodding, smiling, verbal encouragement).
- Do not overlook or ignore inadequate performance; however, correct in a compassionate manner that clearly identifies gaps in knowledge or skill without causing humiliation or resentment (often done privately if possible).

When correctly applied, probing learners' thinking is very engaging and highly rewarding for medical educators and learners; however, it is time- and effort-intensive, so it should be used judiciously on the most important

concepts, and it must be executed correctly in an environment of psychological safety (Stoddard and O'Dell 2016).

Tip 6: Break away from the Initiate-Respond-Evaluate (I-R-E) pattern

Traditional question and answer patterns between educators and learners follow an I-R-E pattern: Initiate (educator), Respond (learner), Evaluate (educator) (Almasi 1996). The following is an example of the IRE pattern:

Medical educator: Thomas, how do we treat hypertension in this patient?

Learner: I would start by talking to the patient about some lifestyle changes.

Medical educator: Good, that's right.

Despite the fact that the medical educator's response is often positive and reassuring when the medical educator responds it ends further thinking and discussion (Wink 1993). In order to encourage learners to think critically and respond at higher-order levels, medical educators need to use the 'third-turn response' to prompt and probe further and invite other learner responses which can further learning (Ford-Connors and Robertson 2017). Ways to use the third-turn response to increase learning include:

- Asking learners to co-construct the evaluation. For example, 'Can someone explain why that is a good option at the moment?'
- Asking for a further explanation. For example, 'Can someone explain under what circumstances we might turn to a pharmaceutical intervention?'
- Asking learners to agree or disagree. For example, 'Would someone like to challenge that? Are there other things we should consider?' (Wink 1993)
- Building on the learner's response by making clinical reasoning explicit. For example, 'You are correct that based on the usual guidelines we should start with a conversation about lifestyle changes. However, in this case, I know that this person has an eating disorder in their background, and I would worry about exacerbating that. So, instead I might start with ...'

In each case, the goal is to use the third-turn response to continue the process of learner discussion rather than stop the conversation and thinking (Ford-Connors and Robertson 2017).

Tip 7: Allow learners to discuss in pairs before answering questions

In the classroom setting, when learners are allowed to discuss important questions with each other before answering, understanding is deepened. Discussion is one form of cooperative, active learning. Kuh et al. (2011) found when learners are actively participating in the discussion, they learn more than when they merely listen. Working in pairs makes it virtually impossible for learners to avoid participating, thus making each person accountable for thinking, learning and adding to the collective learning of the class. Results from Smith et al. (2009) indicate that peer discussion enhances the understanding, even when none of the

learners in a discussion group originally knows the correct answer. Additionally, cooperative learning helps learners think out loud about their understanding, identify misconceptions or gaps in knowledge and give learners an opportunity to teach the information to another person – known to help knowledge retention and deeper understanding (Smith et al. 2009).

Clearly, there is not enough time to allow learners to discuss all questions in pairs before answering. Questions that are good for paired discussions are asked based on (a) difficult concepts about which learners often have misconceptions, (b) main learning objectives that learners need to master, and (c) issues that do not have a clear right or wrong answer.

Tip 8: Give learners think-time after asking a question

Medical learners need to eventually be able to think and respond quickly on their feet, but when concepts are new, learners need think time (Rowe 1986). Think time allows learners to think through and explain their answers. Rowe (1986) constructed the concept of 'think-time,' defined as a distinct period of uninterrupted silence by the educator and all learners so that they both can complete appropriate information processing tasks, digest feelings, and develop oral responses and actions. When educators ask learners questions, they typically wait about one second for a response (Rowe 1986). Educators are often tempted to fill the silence with hints, their own answers, or a response from a quicker responding learner (Cho et al. 2012). A review of research (Tobin 1987) found that waiting at least 3 seconds after asking questions, and more time for English language learners, had significant benefits:

- Longer learner responses
- More learner discourse
- Increase in alternative responses
- Increase in the complexity and cognitive level of learner responses
- More learner-initiated discourse
- More learner to learner interactions
- A decrease in learner confusion
- More confidence
- Higher achievement

Medical educators should challenge themselves to provide longer think-time by silently counting to three after asking questions. The silence may feel awkward at first, but medical educators and learners will become used to it. When medical educators state that they are purposely giving think-time, some awkwardness can be alleviated.

Tip 9: Know when to stop questioning

There will be times when learners are unable to answer questions posed, even when provided with scaffolding or think-time. A learner might be able to answer some of the questions but not all. A learner might be able to answer a few questions, but when probed further they are challenged beyond capacity. The entire class might not be able to answer a question posed because it is very challenging, or they are unprepared. When questions become

unanswerable for learners, medical educators have a few options:

- Ask another learner to help answer
- Ask learners to research it and report back in the next class session (McKibbon and Marks 2001)
- Step in and explain part of the answer
- Step in and explain the entire answer

All of these options are acceptable, and their use should depend on the situation. For example, if the learners should know the answer as a result of their preparation and it is the main learning objective, then it makes more sense to ask another learner to help answer or assign the group of learners to research the answer and report back. If the question is moving learners beyond the learning objectives for that session, it makes sense to ask learners to research it and report back or step in and explain the answer. If a learner appears to understand or remember the answer after a partial explanation from the medical educator, then the medical educator should allow the learner a chance to explain the rest. It is important for the medical educator to pay attention to what is happening with the learner or learners and adjust how they respond to unanswerable questions accordingly (Koole and Elbers 2014). Medical educators should not always assume learners didn't prepare, and medical educators should not always step in and answer the entire question. However, there are times when learners have reached frustration and it is apropos to step in and explain the answer in full to alleviate cognitive load (Kirschner et al. 2006). When medical educators do step in and explain, they need to follow-up by checking for learner understanding and asking the learner to summarize (Van de Pol et al. 2010).

Tip 10: Listen to learner responses

Medical educators ask questions to help learners think, to scaffold their learning, but also to assess learners' knowledge and decide what needs to be taught next (Amin and Khoo 2003; Pylman and Ward 2020). Accomplishing any of those tasks requires that medical educators listen to their learners. During a teaching moment, many words are spoken. Medical educators must learn how to focus on learner responses for the purpose of future instruction (Sherin and van Es 2005). Expert educators tend to have check-points where they assess learners' progressive understanding of the material (Leinhardt et al. 1991). Medical educators need to pay attention to how learners respond in order to craft the next question to further their understanding. While listening to learner responses may appear obvious to some, in practice medical educators need to listen in order to respond to both learners' emotional needs and their content needs. Effective educators pay attention to learner responses noting:

- Did the learner understand the concept? How do I know?
- What level of understanding did the learner response reveal? Did the learner just know the basics, display a surface level understanding, or provide a full

understanding of the concept? Should I call on another learner to add?

- Was there a misconception? Should I call on learners to question the response?
- Was this question too difficult for the learner? How can I break it down to better scaffold?
- Based on learner responses, should I go back (reteach) or forward in my teaching?
- Was the learner able to justify their response (explain why)? Educators need to make sure learners didn't give the right response for the wrong reasons.

When medical educators really listen to learner responses, not simply for the correct answer but for what learners may be saying and how responses can be leveraged for further teaching moments.

Tip 11: Ask questions for a written response

When asking questions, medical educators usually hear a response from one or a few learners and are left wondering what all learners were thinking. Asking questions for written response helps medical educators in the classroom setting collect responses from all learners. In this way, medical educators are able to gauge understanding or see the thought processes of individual learners or the class as a whole.

Asking questions for a written response can be done through quick writes, exit slips, or digital conversations.

- Quick writes: The medical educator poses a question and asks learners to take 1–2 minutes writing their own thoughtful responses.
- Exit slips: At the end of a class session the medical educator asks 1–2 questions such as 'What was clarified for you today?' 'What still confuses you?' 'What is something you learned from another person in your group today?' Learners write their own answers and hand them in as they leave class.
- Digital conversations: The medical educator creates a shared online document where the medical educator and/or learners pose questions and write responses to each other. This document can be added to before, during, and after class sessions.

In each of these examples, the medical educator is asking well-developed questions not to evaluate or grade, but to assess learner thinking and use it to guide further instruction – this is *formative* assessment (Heritage 2007). Medical educators need to make it clear to learners the purpose of the written responses, and that the writings are not for evaluative purposes but for the purpose of planning future instruction. Responses may or may not be anonymous depending on whether the medical educator desires to know about individual learners or gauge the class as a whole.

Tip 12: Analyze the questions asked

It is common for educators to be unaware of the types of questions they ask, whether they give enough think-time, or whether they are using the I-R-E pattern of questioning

(Sherin and van Es 2005). Video or audio recording classroom sessions can help medical educators analyze many aspects of their teaching including their questioning. Analyzing questioning involves recording a session, listening to the recording, writing down the questions the medical educator asked, and analyzing according to:

- Bloom's Taxonomy – levels of questioning
- Use of the IRE pattern
- Probing or prodding
- Quality of learner responses
- Use of think-time

If medical educators are teaching in the clinical setting, the recording might not be an option. Instead, medical educators can ask learners to give feedback on the way medical educators are asking questions, or they can ask a colleague to observe and take note of specific questioning techniques.

Conclusion

Questioning will always be a common teaching strategy in medical education. When used incorrectly questioning can leave learners feeling singled out and not in a position to learn, or worse – threatened or humiliated. When used effectively, questioning is a powerful learning tool. Therefore, medical educators deserve further development around questioning techniques. Effective questioning using the tips provided here will help medical educators support struggling learners, challenge advanced learners, assess learner understanding, and balance learner participation and engagement. The more targeted medical educators can be in asking effective questions, the more likely medical education can develop thoughtful clinicians ready to take on the challenges of today's medical field.

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