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NOT ANOTHER BORING LECTURE: ENGAGING LEARNERS WITH ACTIVE LEARNING TECHNIQUES

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□ **Abstract—Background: Core content in Emergency Medicine Residency Programs is traditionally covered in didactic sessions, despite evidence suggesting that learners do not retain a significant portion of what is taught during lectures. Discussion: We describe techniques that medical educators can use when leading teaching sessions to foster engagement and encourage self-directed learning, based on current literature and evidence about learning. Conclusions: When these techniques are incorporated, sessions can be effective in delivering core knowledge, contextualizing content, and explaining difficult concepts, leading to increased learning.   © 2015 Elsevier Inc.**

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INTRODUCTION

Traditionally, didactic sessions are lectures that rely on the instructor delivering information to learners through passive learning, with the goal of knowledge acquisition. These sessions are widely used in medical training programs to deliver core content and are considered an appropriate learning method to include in an emergency medicine (EM) curriculum [1]. However, active learning results in improved knowledge retention and creates a deeper understanding of material than passive learning can achieve by shifting the focus to the learner's needs and requiring active participation of learners [2,3]. This fosters engagement and encourages self-directed learning [4,5]. The last few decades of problem-based and team-based learning at medical schools have generated strong evidence in support of using these techniques for understanding evidence-based medicine, communication skills, and self-directed learning [6]. These skills are well aligned with the overarching goal of EM residency programs to train residents to become competent EM physicians capable of independent practice by the completion of training.

We describe techniques and provide examples that can be used by medical educators to create active learning sessions both within the context of traditional didactic sessions and through more innovative approaches (Table 1). The diverse menu of techniques described enables medical educators to choose the most appropriate method to achieve the desired learning outcome while considering their available resources (Table 2). In addition, the review of the references will provide further information about these techniques. When active learning techniques are used, didactic sessions can be an effective tool to contextualize content, explain difficult concepts, and improve student learning from simply remembering to applying and analyzing [7].

Table 1. Matrix of Active Learning Techniques

Technique	Definition	Resources Needed	Faculty Requirement	Preparation	Didactic or Cooperative
Pause procedures	A brief pause in a learning session to allow learners to clarify and assimilate information.	None	One per any sized group	Minimal	Didactic
One-Minute Paper	A type of pause procedure. Pose a question to the group related to the information that was just presented and ask them to write down their response.	None	One per any sized group	Minimal	Didactic
The Muddiest Point	A type of pause procedure where learners reflect on and share areas of confusion.	None	One per any sized group	Minimal	Didactic
Think-Pair-Share	Pose a question to the group and have learners consider their response individually. Next, instruct learners to pair with a neighbor to compare responses and reach consensus. End by randomly calling on pairs to share with the group.	None	One per any sized group	Minimal	Didactic
Case-based learning	A technique that use vignettes of real or hypothetical patients to facilitate a discussion.	None	One per any sized group	Moderate	Didactic
Concept maps	A technique that involves visualizing relationships between concepts by creating a diagram. Can be done individually or in groups.	If being used as a note-taking aid, a partially completed concept map will need to be provided.	One per any sized group	Moderate	Didactic or cooperative
Role-play	Learners act out a part or a particular viewpoint to better understand the concepts and theories being discussed.	None	One per any sized group	Moderate	Didactic/can be cooperative
Commitment activities	Exercises that force learners to make a decision. Can be done individually, in pairs or groups.	Audience response system – flash cards, clickers or online audience response program IF-AT® cards	One per any sized group	Moderate	Didactic
Jigsaw	A topic is divided into several smaller, interrelated pieces. Each member of the team is assigned to read and become an expert on a part of the topic. After each person has become an expert, they teach their team members about their piece. After each person in the group is finished teaching their portion, the puzzle is assembled.	Prereading	This can be done with one faculty member, but additional faculty members can be helpful facilitating small groups	Extensive	Cooperative
Team-based learning	Small-group learning that involves preclass preparation so that learners are ready to learn. This is followed by a classroom portion where learners are tested on the preclass material and then challenged to apply core content to scenarios as a team.	Prereading Test materials Cases	One faculty member facilitating multiple small groups	Extensive	Cooperative
Problem-based learning	Case-based learning in small groups.	Cases	One faculty member for each small group	Extensive	Cooperative
Thinking Hats	During this exercise, learners wear different metaphorical hats that represent a different way of approaching a problem or topic.		One faculty member for small–medium-sized group	Extensive	Cooperative

Table 2. Examples of Methods for Different Educational Needs

Examples of Desired Content	Example Learning Objective(s)	Technique	How to Use
• Medical knowledge	• List common etiologies of fever in neonates	One-Minute Paper	After a discussion of the management of febrile neonates with fever, ask learners to list etiologies of fever in neonates.
• Medical knowledge	• Demonstrate appropriate selection of antibiotics for febrile neonates	Think-Pair-Share	After a discussion of the management of febrile neonates with fever, ask the group to individually consider what an antibiotic regimen would be for a neonate with fever. Next, instruct learners to pair with a neighbor to compare responses and reach consensus. Finally, the instructor randomly calls on pairs to share with the group.
• Medical knowledge	• Demonstrate appropriate selection of antibiotics for febrile neonates	Commitment activities	After a discussion of the management of febrile neonates with fever, ask learners to choose an appropriate antibiotic regimen from a list of choices. Instruct learners to text their response using Poll everywhere technology. Review the correct selection and why the other options are incorrect after polling is complete.
• Medical knowledge and clinical reasoning	• Differentiate appropriate evaluation for a well-appearing febrile child based on age	Concept maps	Ask learners to create an algorithm for the evaluation and treatment of a febrile infant based on age
• Medical knowledge and clinical reasoning	• Differentiate appropriate evaluation for a well-appearing febrile child based on age	Case-based learning	Facilitate a discussion of the medical management of febrile children by using several different vignettes of children of varying ages with fever
• Medical knowledge and clinical reasoning	• Develop an evidence-based approach to young febrile infants • Understand gaps in evidence in care of young febrile infants • Create a guideline for the care of young febrile infants	Jigsaw	Each small group is tasked with creating a guideline for the care of young febrile infants. Assign different subtopics to group members (e.g., urinary tract infections, meningitis, infants with bronchiolitis and fever, herpes simplex virus). Providing resources may standardize the information and improve efficiency. Next, rearrange learners to form expert groups by placing all students with the same assigned subtopic together to discuss their topic and develop expertise in the area. Finally, learners return to their original groups (sharing groups) to teach the other learners about their area of expertise and learn from each other, thus putting the pieces together and forming the final product. After learning about the subtopics, groups will create a guideline for the care of young febrile infants.
• Medical knowledge and clinical reasoning	• Develop an evidence-based approach to young febrile infants • Understand gaps in evidence in care of young febrile infants	Problem-based learning	Assign a case of a febrile 6-week-old infant to the small group. During the initial session, learners will discuss the evaluation and management and identify additional information needed to address the case (e.g., rate of serious bacterial infection in this age group, organisms responsible for illness, effect of vaccinations on risk of serious bacterial infection or risk of fever, rates of serious bacterial infection when another etiology is identified such as cellulitis or bronchiolitis). Prior to the next session, group members focus their learning to fill the knowledge gaps identified (asynchronous credit can be provided for this). In the second session, learners complete the case with the information they have gathered since the last session.
• Systems-based practice	• Develop a strategy to ensure all neonates with fever receive antibiotics within an hour of arrival	Thinking Hats	Assign learners a different metaphorical hat to wear that represents a different perspective of a different team member (resident, attending, nurse, pharmacist, patient) identify all of the steps necessary to complete this task and to brainstorm ways to become more efficient or work together.

Table 2. Continued

Examples of Desired Content	Example Learning Objective(s)	Technique	How to Use
• Ethical skills	• Understand viewpoints of parents refusing care	Thinking Hats	Describe a scenario of a parent refusing evaluation and treatment for their neonate with fever. Assign learners a different metaphorical hat to wear that represents a different perspective (physician and parent) and consider their position.
• Communication skills	• Demonstrate effective communication with a parent refusing care	Role-play	Describe a scenario of a parent refusing evaluation and treatment for their neonate with fever. Assign learners different roles (physician talking to parents and parent refusing care) and have them role-play the scenario.
• Psychomotor skills	• Identify equipment needed to perform lumbar puncture (LP) • Identify basic anatomic landmarks • Perform all steps of LP • Use aseptic technique	Simulation	Have learners perform a lumbar puncture using a neonatal LP trainer. Assess using checklists for equipment needed for procedure and steps necessary to complete procedure.

These are examples of how each method could be used, but they are only limited by the creativity of the instructor in terms of types of content that may be covered. For example, One-Minute Paper could instruct on professionalism or clinical reasoning.

DISCUSSION

Techniques To Increase Active Learning During Lectures

Given the comfort of medical educators with the "lecture" method, we will start by describing techniques that can be incorporated into previously designed didactic sessions. Examples of these techniques are pause procedures, small group activities, case-based scenarios, role-play, and commitment-generating exercises.

Incorporate pause procedures. During a didactic session, take a brief pause to allow learners to clarify and assimilate information. The *One-Minute Paper* is a versatile method that can be used to perform a pause procedure (8). Pose a question to the group related to the information that was just presented and ask them to write down their response. Alternatively, ask learners to summarize the key points of the material that was covered. This simple and quick pause in the session provides a change of pace while giving an opportunity for reflection and internalization of the material. When this pause is followed by a brief discussion, learners have an opportunity for self-assessment in a low-stakes environment (8,9). Pause procedures can also be used at the end of a session to assess what students have learned and to identify areas that need to be clarified in future sessions (*the Muddiest Point*) (8).

Turn a large didactic session into small group sessions. Small group sessions increase interaction and allow all learners the opportunity to participate more readily (10). Small groups may be challenging to incorporate due to the increased faculty time commitment to run the sessions. More recent approaches such as team-based learning require less faculty time, but require advance preparation by the learners. Problem-based learning is a specific technique of case-based learning with a group of learners and a faculty facilitator (see sections on team-based and problem-based learning for further details) (11,12). One technique to take advantage of the small-group benefits in the midst of a more traditional lecture is *Think-Pair-Share* (13). Pose a question to the group and instruct learners to consider their response individually. Independent reflection time will vary based on the complexity of the question posed. Next, instruct learners to pair with a neighbor to compare responses. Encourage pairs to reach consensus and then randomly call on pairs to share with the group. This technique provides learners time to organize their thoughts prior to sharing and allows all learners the opportunity to explain their thinking, encouraging reflection and self-identification of areas that need clarification. The last step of randomly calling on pairs to share with the group encourages pairs to stay on task (14–16).

Tell a story. Information received by the learner as a narrative is more readily understood, and subsequently retrieved and applied, than information received as unrelated facts (17,18). Case-based clinical vignettes can be easily incorporated into didactic sessions. Describe a real or hypothetical case and facilitate a discussion to lead learners through particular aspects of the case, depending on the learning objectives (e.g., clinical manifestations, development of differential diagnosis, diagnosis, management). Throughout the narrative of the case, facilitate a discussion at each decision point. A case can be used at the beginning of the session to simply introduce a topic and create interest, or it can be used in the middle or at the end of a session to provide learners an opportunity to review and apply material covered. An alternative to using a case for decision-making is to use a case to demonstrate critical thinking by having a faculty member or senior resident talk through a case. This provides cognitive modeling for the learners. This technique is utilized in the learning module on pediatric sedation found on the peer-reviewed, educational Web site MedEdPortal® (19).

Cases can also be used to cover more challenging competencies such as professionalism, interpersonal communication, or patient safety. For example, after hearing a scenario of parents refusing care for their ill-appearing infant, learners can first discuss medical management and then address discussing treatment options with the family. Trainees report that case-based learning is engaging, and overwhelmingly would like more of these experiences (20).

Draw a map. When new knowledge is linked to previous knowledge and a preexisting cognitive framework, meaningful learning occurs (21). One effective method is constructing concept maps that visually represent knowledge organization (22–24). Learners first identify general topics to place at the top of the map and then identify more specific concepts to place underneath. Next, learners tie the specific concepts with the general concepts through the use of linking words. Finally, learners look for cross-linkages that tie concepts from one side of the map to the other (25). Example concept maps and detailed instructions are provided by Torre and colleagues (26). This technique was originally described by having learners create a concept map from scratch, as described above, which allows them to completely engage with the material. Alternatively, a partially completed concept map can be given to learners to use as a note-taking aid during the didactic session (27). Another use of this technique would be to ask learners to create a treatment or diagnostic algorithm,

such as the approach to the evaluation and treatment of a febrile infant based on age (28).

Learn by doing. Experiential learning incorporates many principles of learning by motivating learners to solve problems, build on prior experiences, and be actively involved. Simulation is an example of experiential learning that is widely used. It replaces or amplifies real experiences with scenarios designed to replicate health encounters. It is commonly used to teach procedures and to practice responding to rare events such as a patient in cardiac arrest. In addition, simulation has been shown to improve medical knowledge, competency with procedures, and communication (29). It is also possible to incorporate experiential learning into a didactic session with the use of *role-play*. Learners act out a part or a particular viewpoint to better understand the concepts and theories being discussed. This can be done in small groups, or a select group can perform the role-play while others provide feedback. An example of this would be role-playing the disclosure of a medical error, with one resident acting as the patient and another resident acting as the physician involved in the medical error.

Get a commitment. Audience response or questioning during lectures is another way to incorporate active learning into a session. When learners grapple with a question and commit to an answer, they are more likely to process and understand the material. By using audience response tools to answer questions in a didactic session, there is the additional benefit of immediate feedback to reinforce concepts and correct misconceptions. There are several options available for audience-response that vary in price and required technology. The most basic tools, such as learners displaying color-coded cards in response to an instructor's question, are inexpensive and do not rely on technology (30). However, learners may be reluctant to respond when others can see their answers. Electronic audience response systems allow learners to reply anonymously and have been shown to increase student motivation, improve understanding, and result in higher examination scores (31,32). The traditional form requires hardware and a significant investment to purchase the "clickers" and the software. Another option is to use a Web-based program that allows learners to use their mobile devices to enter responses via text-message (33,34). These systems allow for sharing of text instead of simply sharing multiple-choice selections, allowing for more advanced answers. A final method is the use of immediate feedback via scratch-off cards (*IF-AT® cards*), which enables timely assessment and feedback on the accuracy of student answers (35).

Flipped Classroom Method Alternatives to Standard Lecture Didactics

The next section will focus on methods that can be used in lieu of standard didactic sessions. These sessions all rely on the concept of the flipped classroom, where traditional homework and classwork are "flipped." Instructional content is delivered outside the classroom in the form of "pre-learning" prior to the in-class session, and the time in class is then spent applying the knowledge and developing skills. Pre-learning can be in the form of an article, book chapter, podcast, or Web-assisted learning. Ideally, pre-learning is performed independently at a convenient time for the learner, to allow the learners to learn at their own pace. In the setting of an EM residency, residents might obtain credit for asynchronous learning. Although not optimal, the pre-learning can also be performed at the beginning of the educational session with either assigned pre-learning or a brief didactic. The goal of the pre-learning is for learners to learn content prior to class session. The class time then becomes an application exercise as an interactive session where the knowledge acquired prior to the class can be applied and synthesized. These methods facilitate in-depth learning and dynamic in-class discussions (36). At our institution we lengthened the time of our journal club and dedicated the first portion to the "pre-learning" of reading the articles individually to ensure that the articles were read, followed by discussions of the articles. An in-depth discussion of the flipped classroom is described by Vanderbilt University Center for Teaching (37).

Utilize cooperative learning. Cooperative learning provides opportunities for problem solving, discussion, and consensus building in an educational environment. This is distinctly different from other types of group sessions in that it requires face-to-face interaction, individual accountability, group processing, and positive interdependence of team members (38). One way to incorporate cooperative learning is by using the *Jigsaw technique* (39). Start by dividing the class into multiple teams of learners, with the goal of student collaboration to master a topic or solve a problem. Assign each team member a different piece of the topic (puzzle) to master, and allow adequate time for individual learning either prior to class with assigned pre-reading or during the session itself. Providing resources may standardize the information and improve efficiency. Next, rearrange learners to form expert groups by placing all students with the same assigned subtopic together to discuss their topic and develop expertise in the area. Finally, learners return to their original groups (sharing groups) to teach the other learners about their area of expertise and learn from each other, thus putting the pieces together and forming

the final product. This cooperative learning technique was originally developed to improve relations between learners in the classroom and has since been shown to be an effective way of engaging learners in a variety of learning environments (39–42). We have used this technique to teach the approach to the care of early pregnancy bleeding. Each student in a group is assigned pre-work of a different topic relevant to early pregnancy bleeding (e.g., role of ultrasound, ectopic) on which to become an expert. After developing expertise in their expert group, learners formed sharing groups where learners created an algorithm for the approach to a patient with early pregnancy bleeding.

Work in teams. Team-based and *problem-based learning* are cooperative instructional methods that have been adopted by many medical schools, for use in the preclinical years. We will touch on these briefly and provide references for those desiring further training. Team-based learning utilizes active small-group discussion facilitated by an instructor (43–45). Teams solve clinical problems and receive immediate feedback on performance. Team-based learning has been shown to improve learning outcomes and examination scores, communication processes, teamwork skills and the value learners place on these skills, and student engagement in class settings (46). With team-based learning, a single instructor can provide a small group atmosphere within the time and space of a large classroom setting. There are three phases of team-based learning. The first phase involves pre-class preparation so that learners are ready to learn. The classroom portion holds learners accountable for the pre-class material and solidifies core content. In class, learners also encounter challenging scenarios to apply the material they have learned. An example of team-based learning—Navigating Delirium, Polypharmacy and Home Care Services with an Elderly Emergency Department Patient—can be found on MedEdPortal (47).

In problem-based learning, a facilitating faculty member gives a case to the group. During the first session, the group works through the case and identifies additional information they need to learn to address the case. Prior to the next session, group members focus their learning to fill the knowledge gaps identified (asynchronous credit can be provided for this). This provides in-depth understanding, accountability, and self-directed learning. In the second session, learners complete the case with the information they have gathered since the last session. A learning module of abdominal pain in a pregnant woman using problem-based learning can be found on MedEdPortal (48).

Put on your thinking hat. The Thinking Hats method is a variation of role-play that encourages critical thinking

and allows a group to explore a problem from a variety of viewpoints (49). During this exercise, learners wear different metaphorical hats that represent a different way of approaching a problem or topic. Each "hat" may represent the perspective of a different team member (resident, attending, nurse, patient), factors that contributed to a patient outcome (e.g., institutional culture, teamwork & communication, process, environment, equipment, people), or different thinking approaches (optimistic, cautious, informative, emotional, reflective, creative). We have used this in performing a mock root cause analysis. Members of the class were chosen to represent each different team member involved in the incident and were asked to consider the incident from that individual's viewpoint during the exercise.

CONCLUSIONS

When learners are engaged and learning principles are utilized, didactic sessions can be extremely valuable. The tips outlined above can be used together or separately to increase interactive learning. Each of these techniques incorporates different learning styles to engage a wide variety of learners.

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ARTICLE SUMMARY

1. Why is this topic important?

Most emergency physicians are involved in teaching peers, nurses, or trainees and rely on traditional lecture methods. Unfortunately, learners retain very little of what they hear in lectures and are often unable to apply what they heard in lectures.

2. What does this review attempt to show?

This review describes techniques that can be used to increase retention and facilitate knowledge transfer to improve patient care.

3. What are the key findings?

Increasing engagement in learning sessions results in more meaningful learning.

There are several simple strategies that can be used to increase learner engagement.

4. How is patient care impacted?

When learners are engaged and knowledge is applied during a session, they will have an easier time applying their knowledge and skills to patient care.