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EDUCATIONAL FORUM

WILEY Congenital Heart Disease

Teaching pediatric cardiology with meaning and sense

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Abstract

Pediatric cardiologists teach complicated concepts to a diverse group of learners that include medical students, nurses, residents, fellows, patients, and parents. Unfortunately, much of what is taught is not retained. In order to increase the likelihood of long-term retention, a cardiologist should teach with both meaning and sense. The authors provide a review of these concepts and give specific examples of how to teach in ways that both make sense and are meaningful to a cardiologist's leaners.

KEYWORDS

education, meaning, sense, teaching

> Never try to teach a pig to sing. You waste your time and you annoy the pig.
>
> Robert A. Heinlein[1]

As teachers, we have all had experiences during, which we felt like we were wasting our time and annoying our students. However, even when our learners are engaged, most of what we teach is not retained in their long-term memory. This can be disheartening for any teacher, including a pediatric cardiologist. A cardiologist is responsible for teaching a variety of learners including nurses, medical students, residents, fellows, patients, and parents. Even in a nonacademic setting, a cardiologist must regularly teach patients and their families about heart disease. These learners have diverse backgrounds, knowledge, interests, and educational needs. This can seem overwhelming when combined with the fact that few cardiologists have formal training in education. However, a brief review of the two most significant determinants of long-term memory storage can help clinicians improve the effectiveness of their teaching. Specifically, material is most likely to be encoded into long-term memory if it is taught with both *meaning* and *sense* as shown in Figure 1.[2]

Knowledge or skill is *meaningful* if it has value to the learner and direct application to the learner's future. For retention to take place, the learner should answer "yes" to the question "Is this relevant to me?" If the answer is "no," then it is unlikely he will retain what is taught. For example, a pediatric resident who plans to become a general pediatrician may not see a reason to learn the nuances of single ventricle palliation. Therefore, no matter how well the material is taught, he is unlikely to retain it. However, the same resident may recognize that part of his future practice will involve differentiating between innocent and pathologic murmurs, so teaching this skill is much more likely to result in retention. If he has not yet made this connection, a teacher should point out why this topic is important for his future and the possible consequences of not acquiring this skill (eg, his inability to diagnose a pathologic murmur could result in harm to a child). In this way, a teacher should focus on teaching not only *what* is meaningful, but also *why* it is meaningful.

Knowledge and skill make *sense* to the learner if they are comprehensible. They should fit within a learner's current understanding of the world rather than be memorized as a piece of information isolated from prior knowledge. The learner should be able to answer "yes" to the question "Does this make sense?" For example, when teaching a pediatric cardiology fellow that left-sided heart dilation is anticipated with a large ventricular septal defect (VSD), the teacher must explain how the VSD causes left heart dilation. One of my (JD) favorite senior cardiologists used to encourage fellows to "be the red blood cell" and describe sequentially the heart chambers through which the cell flows for each heart lesion. In many cases only after completing this exercise does a new cardiology fellow understand why a large VSD causes left heart dilation. After having come to this realization, it is unlikely that the fellow will forget this association.

Given the diverse nature of the learners we teach, it is paramount for a cardiologist to know the backgrounds and trajectories of his learners in order to ensure that what he teaches is both meaningful and makes sense. Below are some specific examples of ways a pediatric

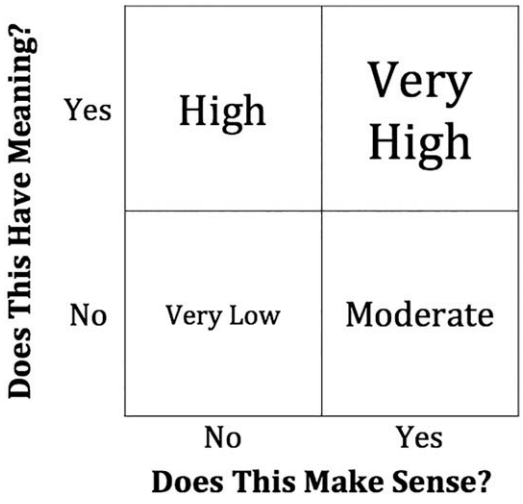

FIGURE 1 The probability of storing information

cardiologist can teach with both meaning and sense to specific learners:

- *Parent of a child with a bicuspid aortic valve*: A cardiologist could explain that ascending aorta dilation is caused by a combination of turbulent flow combined with weakness in the vessel wall (*sense*). In addition, understanding the risk of ascending aorta dilation is important because dilation is usually asymptomatic, and a patient's first symptoms could occur during a dissection or rupture, at which time the opportunity for life-saving intervention may have been missed (*meaning*). It is unlikely that a parent or patient who understands this risk will forget it or miss a future cardiology visit.
- *Pediatric resident learning about neonatal coarctation of the aorta*: As opposed to teaching the details of the surgical intervention and immediate postoperative care, a cardiologist could focus on the infant's initial presentation to a pediatrician, which is more likely to be applicable to the learner (*meaning*). The cardiologist should explain that the patient will present in obstructive shock (absent lower extremity pulses, tachypnea, and acidosis) following closure of the patent ductus arteriosus (*sense*). The teacher could then engage the resident in a discussion about what would happen if the pediatrician failed to recognize the patient's condition to further enforce why this is important (*meaning*).
- *Bedside nurse caring for an infant with hypoplastic left heart syndrome*: A cardiologist should teach what the patient's goal oxygen saturations are (75%–85%), why this is important (*meaning*), and a rationale for this saturation range (*sense*). The cardiologist could explain the basics of "complete mixing" and why it is impossible for the baby to have an oxygen saturation of 100%. Additionally, it should be explained that this is important because a saturation of 96% (an otherwise normal saturation in biventricular circulation) would indicate significant pulmonary over-circulation and impending decompensation.
- *Pediatric cardiology fellow evaluating a patient in clinic with a small perimembranous VSD*: The cardiologist could explain that a possible complication is the development of aortic valve prolapse and aortic insufficiency from the high-velocity jet causing a low pressure zone due to the Venturi effect (*sense*).[3] Understanding this risk is important because progression of aortic valve disease is usually asymptomatic until the insufficiency is severe, and the damage to the aortic valve is typically irreversible (*meaning*). Thus, regular cardiology follow-up is essential.
- *A new third-year medical student rounding on the inpatient cardiology service*: Rather than focus entirely on the nuances of each patient's congenital heart disease, a cardiologist could instead teach a topic more applicable to the medical student such as oral presentation skill. The cardiologist should emphasize how grades during clinical rotations are strongly influenced by presentation skill and how learning to communicate medical information clearly and concisely will be important for the physician-in-training regardless of area of specialty (*meaning*). In addition, the cardiologist should explain the rationale for the different components of an oral presentation and how the subjective and objective data are interpreted in the assessment of the patient, which in turn supports the development of a plan (*sense*). This should be reinforced throughout rounds as the cardiologist consistently redirects the student's presentations and asks questions to encourage the interpretation of data and the development of a plan.

While both meaning and sense increase the likelihood of retention, meaning is more important and should receive the greatest emphasis by the teacher. To focus on what is meaningful to his learners, a cardiologist must first assess their knowledge, skill, training level, and future plans. The better a teacher knows his students, the more effectively the material can be tailored to their needs. At times, this tailoring may require a cardiologist to deviate from an assigned teaching topic or only cover a portion of the material that was originally planned. As an exercise, we recommend that each cardiologist create a list of those he teaches, identify two or three topics that are likely to be meaningful for each learner, develop a strategy for teaching these topics in ways that make sense, and then, apply this approach to your actual students and reflect upon its effectiveness. In conclusion, we recommend that cardiologists approach every teaching opportunity through the lens of their learners with a specific focus on what makes sense and is meaningful for each learner.

INSTITUTIONAL REVIEW BOARD APPROVAL

The study is subject to exemption from institutional review board approval as this study is not research and does not involve human subjects.

CONFLICT OF INTEREST

The authors have no financial relationships relevant to this article to disclose.

AUTHOR CONTRIBUTIONS

All authors made substantial contributions to this article, have participated in drafting or revising this article, and approve the submitted version of this article.

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