

THE CHROMOSOMAL ANALYSIS OF TEACHING: THE SEARCH FOR PROMOTER GENES

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ABSTRACT

The process of teaching is ubiquitous in medicine, both in the practice of medicine and the promotion of medical science. Yet, until the last 50 years, the process of medical teaching had been neglected. To improve this process, the research group at the Stanford Faculty Development Center for Medical Teachers developed an educational framework to assist teachers to analyze and improve the teaching process. Utilizing empirical data drawn from videotapes of actual clinical teaching and educational literature, we developed a seven-category systematic scheme for the analysis of medical teaching, identifying key areas and behaviors that could enable teachers to enhance their effectiveness.

The organizational system of this scheme is similar to that used in natural sciences, such as genetics. Whereas geneticists originally identified chromosomes and ultimately individual and related genes, this classification system identifies major categories and specific teaching behaviors that can enhance teaching effectiveness. Over the past two decades, this organizational framework has provided the basis for a variety of faculty development programs for improving teaching effectiveness. Results of those programs have revealed several positive findings, including the usefulness of the methods for a wide variety of medical teachers in a variety of settings.

This research indicates that the development of a framework for analysis has been, as in the natural sciences, an important way to improve the science of the art of teaching.

Introduction

The process of teaching is ubiquitous both for the practice of medicine and the promotion of medical science. Yet, until the last 50 years, the process of medical teaching had been neglected. Faculty are generally hired on criteria other than teaching, and there is often little incentive to focus on that process, as the promotion criteria often emphasize the other legs of the academic stool. In spite of this lack of

emphasis and often lack of incentive, medical teachers care about this process. In addition, at a mission-based level, institutional leaders hope that they are effectively educating future physicians and scientists. Certainly students, trainees, and ultimately patients benefit from effective teaching.

In 1976, recognizing the importance of teaching and generalism, Dr. Robert Glaser, of the ACCA and then with the Kaiser Family Foundation, and Dr. Daniel Federman, then Chief of Medicine at Stanford, began the first fellowships in General Internal Medicine with several goals, including to assist fellows and faculty to become more effective teachers. I was fortunate to be one of the first fellows in General Internal Medicine at Stanford, and I identified the improvement of medical teaching as my academic area.

Our early work was made possible with the advent of videotapes. Similar to scientists who observed with the microscope, we were able to watch and study the process of clinical education through the lens of the video camera. With this process, including reviewing videotapes of actual teaching with the teachers themselves, we were able to make two important conclusions: First, teachers cared, and second, teaching was difficult (1). Yet, there was no accepted and effective method that was used by most medical teachers to address this important role.

We embarked on a goal to develop effective methods of assisting teachers. In that process, we recognized the need for a systematic scheme for the analysis of medical teaching, identifying key areas and behaviors that could enable teachers to enhance their effectiveness. Therefore, we developed a framework to analyze, understand, and, in turn, improve the process of teaching. This framework, refined in the early 80s, has embodied the key principles used in our work. The description of the framework is the subject of this paper.

Goals

Our research has focused on two goals: (a) to improve the quality of teacher reflection and (b) to improve the effectiveness of teaching behavior. These goals would enable individual teachers to understand when and why their approaches were effective or ineffective and to adapt their behavior to improve effectiveness. Almost all teachers in medicine in the early 80s, and many today, leave less successful teaching episodes feeling ungratified and maybe even disenchanted, knowing that the process did not work. Such feelings can contribute to having very important teachers relinquish this crucial role. Personally, I am concerned that the lack of consistent gratification has led many

scientists to diminish their commitment to teaching in favor of the bench. Increased commitment to the bench can be a useful approach to focus on immediate research, but may also diminish the ability of later generations to carry on the process of science, a long-term risk to the profession.

The complexity of the teaching process has driven our work, with the recognition that there is no one way of teaching that satisfies all educational goals. Teaching and teachers must be versatile, using a wide-variety of teaching methods. The field of education has had many bandwagons which later have proven to have unanticipated or sub-optimal results. For example, even recently the educational process of “problem-based learning,” (PBL) was adopted wholeheartedly by many medical schools as the generic approach to teaching excellence. Although PBL is effective in many ways, research evidence suggests that it is not the panacea that it was once thought (2). By itself, it accomplishes only part of the goals of medical teaching. The “Eureka Phenomenon”—the “I have found it!” phenomenon for teachers is an elusive one, only to be challenged by a different type of learner or different type of content to be taught.

Therefore, our work was guided by a goal that would allow teachers to have a way to understand and improve their teaching, capitalizing on many aspects of the teaching and learning process. Toward that end, we developed an educational framework. The benefit of a framework is known by all physicians in the “review of systems.” We all recognize that the true analysis of a patient’s history requires a systematic review of all organ systems. Similarly, the analysis and elucidation of the teaching process is improved with a systematic framework. In Table 1 the elucidation of the genetic structure is compared to the framework for teaching that we have developed.

Materials and Methods

The development of the framework has been based on (a) empirical findings and (b) the literature in education. Our early work was based on the analysis of videotapes of attending physicians, including interviews with these physicians during review of videotapes of their teach-

TABLE 1
Comparison of Genetic and Teaching Analysis

| Genetics | Teaching |
|-----------------------------|-----------------------------|
| Chromosomes | Categories of Teaching |
| Functionally related groups | Components of Categories |
| Genes | Specific Teaching Behaviors |

ing. These videotapes provided examples of real life clinical teaching episodes in both the inpatient and outpatient setting (1,3).

Ongoing study of the field of education enabled the integration of educational principles and concepts with our empirical observations. This integration resulted in a seven category analytical framework. With continued observations, we defined multiple components of each category. Finally, we identified examples of specific teaching behaviors within each category that could enable a teacher to enhance his/her performance in a given category. In the chromosomal analogy, we defined seven chromosomes, multiple functioning regions, and examples of particular genes that appeared to influence the function of that chromosome and others (Table 1). Thus, we searched for promoter genes, i.e., "promoter" teaching behaviors that could enhance the effectiveness of a related aspect of the teaching process. This category system provides a non-prescriptive approach to teaching, allowing the teacher to identify and choose particular teaching behaviors that further his/her educational goals for the learners. This supports the educational philosophy that there are many ways to achieve teaching effectiveness, and that the final decision on teaching methods must remain in the hands of the teachers themselves. However, the teachers must have a systematic framework to examine their methods.

Results

The Seven Category Educational Framework, Its Components, and Related Teaching Behaviors

Tables 2, 3 and 4 provide the seven categories, their subcomponents, and examples of some of the behaviors identified for teaching improvement. In the language of genetics, we define the chromosomes, the promoter regions, and the individual genes. Work at the University of

TABLE 2
Seven Categories of Teaching

| | |
|----|--|
| 1. | Creating a Positive Learning Climate |
| 2. | Organizing Control of the Teaching Session |
| 3. | Communication of Educational Goals |
| 4. | Promoting Understanding and Retention |
| 5. | Evaluation of the Learner |
| 6. | Providing Feedback |
| 7. | Fostering Self-Directed Learning |

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TABLE 3
7 Educational Categories & Key Components

| |
|-----------------------------|
| LEARNING CLIMATE |
| Stimulation |
| Learner Involvement |
| Respect/Comfort |
| Admission of Limitations |
| CONTROL OF SESSION |
| Leadership Style |
| Focus |
| Pace |
| COMMUNICATION OF GOALS |
| Establishment |
| Expression |
| Negotiation |
| UNDERSTANDING AND RETENTION |
| Organization of Material |
| Clarity |
| Emphasis |
| Fostering Active Learning |
| EVALUATION |
| Observation of Learners |
| Questioning |
| Fostering Self-assessment |
| FEEDBACK |
| Minimal |
| Behavioral |
| Interactive |
| SELF-DIRECTED LEARNING |
| Motivation |
| Resources |

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Indiana confirmed the validity of these categories through a factor analysis of the evaluations of attending physicians (4).

Teaching Improvement: From Theory to Practice

Although the definition of categories of teaching and the identification of possible effective teaching behaviors was an important step, the improvement of actual teaching behavior required much more. In our early work, I was convinced that teachers could change their teaching behavior and their effectiveness simply by learning what could work. However, further work pointed out that knowing what one would like to do is quite different from actually changing one's teaching behav-

TABLE 4
Example of Teaching Behaviors within the Learning Climate Category

| LEARNING CLIMATE | |
|--|---|
| KEY COMPONENTS & SPECIFIC TEACHING BEHAVIORS | |
| 1. | STIMULATION TEACHING BEHAVIORS: –show enthusiasm for topic and for learners –show interest through body language –use animated voice –provide conducive physical environment |
| 2. | LEARNER INVOLVEMENT TEACHING BEHAVIORS: –look at learners –listen to learners –encourage learners to participate –avoid monopolizing discussion |
| 3. | RESPECT AND COMFORT TEACHING BEHAVIORS: –use learners’ names –acknowledge learners’ problems/situation –invite learners to express opinions –state respect for divergent opinions –avoid ridicule, intimidation, or interruption |
| 4. | ADMISSION OF LIMITATIONS TEACHING BEHAVIORS: –acknowledge learner limitations –invite learners to bring up problems –admit own errors or limitations –avoid being dogmatic |

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iors. Beyond conceptual understanding, practice was important as well.

Therefore, the Stanford Faculty Development Center has developed and disseminated training seminars that include both an understanding of educational concepts and a practice of actual teaching behaviors. This two level approach enables a teacher to both recognize general areas to improve as well as identify, choose and practice particular teaching behaviors. This theoretical framework has provided the underpinnings of a variety of faculty development programs, including programs to improve the teaching of general clinical teaching skills and particular teaching approaches in the content areas of: Medical Decision Making, Preventive Medicine, Geriatrics in Primary Care, End-of-Life Care, and Professionalism in Contemporary Practice. In each of these series, faculty are trained to become trainers for other faculty colleagues as well as for residents whose teaching has been shown to be extremely important. Currently, the Center provides two courses: (1) The Improvement of Clinical Teaching and (2) Teaching Professionalism in Contemporary Practice. (<http://sfdc.stanford.edu>)

Our results can be summarized as follows:

- Medical teachers find a model of instructional improvement based on this framework beneficial and would recommend such training to others (5).
- Teaching improvement methods based on the seven-category framework and the framework itself can be useful for a variety of teachers, including academic clinical teachers (5), community-based practitioners (6), residents-in-training, (7) outpatient teachers (8) and basic science teachers (9).
- Changes in teaching brought about by the teaching improvement seminar series are identified by the teachers themselves, as well as by students and blinded observers (9,10).
- Teachers often only recognize the full benefits of the training after they have taken the training—measured by retrospective pre-evaluations (11).
- Further research is indicated to examine
 - the generalizability of the teaching improvement approaches based on this categorical framework;
 - whether these teaching seminars can be effectively delivered by previously trained clinical faculty to non-clinical faculty (i.e., clinical faculty to basic science faculty);
 - the evaluation of enhanced learning and patient care by students and housestaff.

Discussion

Teachers commonly reflect on their performance, living and reliving this important and challenging role. Yet, research on reflection in the professions indicates that the usual method of reflection (i.e., reflection by oneself) can be improved upon by reflection with others and, moreover, with reflection using a systematic framework for analysis. Yet, we commonly do not reflect on the teaching process with colleagues, and in the past, many teachers have not had a framework for analyzing our own teaching. Learning about teaching is a part of our professional role that has been left to learning from experience, that is, learning through the pain of errors, a method that takes a long time and may not always be effective.

Like the research in the field of genetics that moved from the determination of the chromosomal number to the structure and function of related and individual genes, we have searched for a framework that moves from the identification of major categories of teaching to the identification of specific teaching behaviors that can promote learning. As geneticists have hunted for genes that facilitate or impede the function of other genes, we have looked to define teaching behav-

iors that can facilitate or impede learning, often by interacting with behaviors from other categories of teaching. The resultant seven-category framework that has underpinned our work for the last 25 years has enabled teachers to reflect on and analyze their teaching using a systematic approach, identifying not only conceptual areas that can be improved, but also specific behaviors that can be practiced and used. We now look forward to further testing with expanded groups of teachers, with special focus on the teaching of basic sciences.

Medical teachers are representative of many adult learners. They often rely on their own experience for identifying new approaches to their roles, sometimes unaware of advances in other fields, such as teaching improvement methods. Yet, when experienced in such methods, they become advocates and recommend that others enjoy the benefits of training. This result has led us to continue to expand our training, moving now from the focus on clinical teachers to basic science teachers in medical schools. We are enthusiastic that there will be more widespread advances in both the science and the art of teaching for the benefit of the teachers, their trainees and, ultimately, the patients for whom the medical schools were developed.

In sum, the processes we have used in this social science have mirrored the process of discovery in the natural sciences. The outcomes have been similar—a discovery of major aspects and details of the system that can enable us to improve the science and the art of teaching, a critical part of our profession.

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DISCUSSION

George Thibault, Boston: Kelley, that's wonderful and I wanted to congratulate you and your impact over the last 25 years. I think its really a notable moment to reflect on these last three talks of Ron and Fred and Kelley and the increasing centrality of medical education and our willingness to talk about it having this session partly devoted to it. I am a little more optimistic than my revered colleague, Ron, who responded to the question that no, there isn't much movement going on to change this. I think there, in fact, is a movement going on to change this. Kelley, you've had a lot to do with that and with the formation of academies at medical schools around the country to create a community for medical educators to create a service to improve education and to benefit us with innovation. I think it's beginning to catch on, and we are growing that stunted third leg of the stool. And I want to applaud you, and Ron and Fred for the contributions you have made to that.

Skeff, Stanford: George, thank you. I do want to have you all feel exceptionally wonderful about this, because I was told when I first started, "Oh, I am so sorry you are going to start in medicine and the improvement of teaching in medicine, because that's not a group that is going to respond very positively." That has been the absolute wrong conclusion. I think that what we have been doing in medicine is actually now going to provide a model for other professional schools as well. So, it's people like you that in fact responded early and should give us, I think, a lot of good feelings about who we are. Thanks, George.

Allen, Charleston: I think there is one other component that is of great importance to the accentuation of teaching prowess in medical schools. A brief personal comment: I went from an institution where the teaching of physical diagnosis was revered and I happened to love it, and I did it, and I got high accolades. And, in fact, I still cherish a plaque that one of my groups gave me at the end of the year. I went to another institution where they really didn't give a damn, and my group pilloried me as a poor teacher, ineffective, worthless. The result of that was that the Dean's office, I happened to be a chair of medicine at the time, but the Dean's office sent a junior faculty to me to counsel me on my teaching capabilities. Now, what I took away from that experience was that a lot of the improvement in medical education has to start at the top. There has to be a commitment of the institution and of the school that this is a top priority; otherwise, it is just not going to happen.

Skeff: I applaud that idea. It has gone from the ground up at this point. It has not necessarily come in the other direction, but I think your example is a poignant one, that somebody that is doing something exceptionally well, when the tide changes, time and money—I am looking for Ken Ludmerer, who was here earlier—but the time for teaching has been constricted so much that the idea that teaching about physical diagnosis is even an important thing, which should worry all of us, is being challenged. So I would encourage you to chat with your younger faculty colleague and learn everything you can from each other, but don't stop teaching. We are in such a crisis right now. Right now, you know, with the hours regulations, the desire for speed teaching, deciding how are you going to combine science with clinical medicine, deciding how are you going to teach in the lecture hall, how are you going to teach when you've just admitted 12 patients, et cetera, that it is a real challenge right now, and it is a time that we need to be looking at teaching, both for the future not only of clinical education, but I think with this group. I need to emphasize the future of science. I had an opportunity to write an editorial in response to some work that was showing where the residents were finding their role models. I am a believer that the hospitalists are an important group, but the role models were the hospitalists and the scientists were no longer to be found in the clinical teaching situations, and we are now seeing a loss of science emphasis. We have to be very afraid of that. So there's work to be done, but I think we're on the road. Thank you very much.