

COMMENTARY

Guided Discovery Learning with Videotaped Case Presentation in Neurobiology

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ABSTRACT

Research in psychology and education with students at the pre-college level suggests that guided discovery learning is superior to the less-structured approach of pure discovery learning in promoting learning and knowledge transfer.¹ In medical education, guided discovery learning is a learner-centered approach that combines didactic instruction with more student-centered and task-based approaches.² Key features are (1) a framework for student learning, (2) student responsibility for exploring content needed for understanding, (3) study guides provided, and (4) application to clinical or experimental problems. This paper describes an example from an interdisciplinary neurobiology course for first-year medical students. Following didactic presentations of nervous system structure and function, we present an introduction to the clinical case, an outline of the neurological examination, and assignment of a written report. Study resources are provided. This is followed several days later by the presentation of a videotaped case of a patient admitted with a stroke one year ago, with a neurologist taking the history and reviewing the examination at admission. Each segment was followed by the instructor, a member of the neurology faculty, questioning students and inviting discussion on differential diagnosis based upon their knowledge of neuroanatomy and neurophysiology. Students were asked to evaluate this component of the course on a 1-6 Likert rating scale (1=strongly agree to 6=strongly disagree). 79 to 88% strongly agreed or agreed that it “increased my knowledge of neurobiology”, “increased my motivation to learn neurobiology”, “increased my ability to apply neurobiology to clinical problems”, and “improved my understanding, motivation to learn, and/or ability to apply neurobiology more than a typical lecture”. An objective performance measure is cited as an approach to the effect on learning. The results suggest that the clinical case presented by means of guided discovery learning serves to focus on real problems and adds relevance and motivation to mastery of related basic science information.

INTRODUCTION

Guided discovery learning combines didactic instruction with more student-centered and task-based approaches.² Key features are (1) a framework for student learning, (2) student responsibility for exploring content needed for understanding, (3) provision of study guides, and (4) application to clinical or experimental problems.

Influential voices in the fields of psychology and education describe learning as an active process in which the learner constructs coherent and organized knowledge.¹ This view has been referred to as the constructivist view of learning. It contrasts passive instructional methods such as lectures and books with constructivist methods such as group discussions and hands-on activities. Educators have been encouraged to allow students to discover rules and ideas and to solve

problems, often in groups, with little guidance. However, Mayer¹ describes several groups of educational studies that cast doubt on the wisdom of this belief.

One group involved comparing pure discovery methods with little guidance; guided discovery methods, in which the student solves problems but the teacher gives some coaching and/or feedback; and expository methods, in which the student is provided with the correct answer along with the problem. Problems used were logical reasoning tasks of identifying a word that does not belong in a list of other words, or deriving arithmetic formulas. The guided discovery groups were found to perform best by the criteria of retention and transfer to solving new problems. Another group of studies was stimulated by Papert's³ argument that children working in his LOGO environment should discover computer programming concepts on their own without the

intervention of teachers. Subsequent studies, however, showed that students who learned in this manner did not generalize this learning to related tasks, and that guided discovery methods involving modeling by the teacher was more effective in teaching students to write programs. Mayer concludes from these studies that guided discovery learning is superior to the less-structured approach of pure discovery learning in promoting learning and knowledge transfer.

How can these arguments be related to medical education? In their review of learner centered methods in medical education, Spencer and Jordan² begin by asserting that self-directed learning, in which the student is an active participant, encourages a deep approach to learning, that involves an active search for understanding, rather than a surface approach to learning that encourages students to repeat what has been learned. They review several strategies for self-directed learning, including problem-based learning, guided discovery learning, task-based learning, and small-group learning. Problem-based learning (PBL) is seen as promoting deep rather than surface learning, in a more stimulating learning environment, with greater student-faculty interaction, in a manner that promotes knowledge retention and motivation. However, it can have such drawbacks as excessive startup and faculty time, relative inefficiency, less acquisition of basic science knowledge, and implementation difficulties in large classes.

Guided discovery learning combines the best of traditional modes of medical education with more innovative and learner-centered methods.² Usually within an integrated, system-based curriculum or course, a learning framework and objectives (or outcomes) are presented by didactic teaching methods. Students are responsible for exploring the content necessary through self-directed learning, with the help of study guides that are provided. Application to real clinical problems, with discussion, reinforces understanding and motivation.

MATERIALS AND METHODS

A clinical case study will be described as an example of guided discovery learning developed for the interdisciplinary neurobiology course for first-year medical students directed by the author. This is inserted in a mostly lecture-based course following didactic presentations on nervous system structure and function up to and including the cerebral cortex, and is followed by additional lectures. A lecture and handout introduces the goals, especially the ability to apply neuroanatomy and neurophysiology to real clinical cases and to write a summary of how this case can be explained on the basis of neurobiological knowledge. The lecture then gives a preview of the case to be presented on videotape, including presenting problems, history, neurological examination, and differential diagnoses. An outline of the components of the neurological examination is presented, with the categories mental status, cranial nerves, motor and sensory systems, reflexes, cerebellar, and gait, with reference to how these categories can be related to topics already presented. The

requirement for each student to write a one-page report of the diagnosis in terms of neuroanatomy and neurophysiology is then assigned. Students are shown a brief preview of the videotape, and assigned to learn the topics introduced with the help of the course textbook and an internet-based resource.⁴

Approximately one week later, the class meets under the guidance of a member of the neurology faculty, either as a whole or divided into smaller groups. The videotaped case presentation shows a patient admitted with a stroke one year ago, with a neurologist taking the history and reviewing the examination at admission. Each segment is followed by questioning students and discussion on differential diagnosis based upon their knowledge of neuroanatomy and neurophysiology. The beginning of the video shows a patient who one year earlier had an acute onset of hemiparesis, visual field loss, astereognosis, and denial of the severity of his illness. The videotape is then stopped and the class asked to list the presenting problems and then to generate hypotheses for the nature and cause of the problems. Class discussion is open but with guidance and feedback from the instructor. The next segment of the video is then shown. This includes brain (CT) scans and treatment with a thrombolytic agent. Again, the video is stopped and class discussion ensued. The site of the lesion is discussed, and how it might account for the presenting problems. The clinical course with complications followed by recovery is then shown and discussed. Finally, a follow-up neurological examination, showing few residual signs or symptoms, is shown and discussed. Each student submits a one-page printed report after 7-10 days. Grades are assigned based on how well the patient's problems are explained in terms of neuroanatomy and neurophysiology.

RESULTS

To begin to address the value of this instructional method in order to focus on real problems and add relevance and motivation to mastery of related basic science information, students were asked three months after the conclusion of this course to evaluate components of the course on a 1-6 Likert rating scale (1=strongly agree to 6=strongly disagree). 85% strongly agreed or agreed that it "increased my knowledge of neurobiology" (mean rating 2.18, SD 0.27, n=33), 79% that it "increased my motivation to learn neurobiology" (mean rating 2.24, SD 0.22), 88% that it "increased my ability to apply neurobiology to clinical problems" (mean rating 1.82, SD 0.22), and 88% that it "improved my understanding, motivation to learn, and/or ability to apply neurobiology more than a typical lecture" (mean rating 2.09, SD 0.27). Figure 1 (Ratings of students for instructional method using videotaped case) illustrates these responses.¹ In a more general student evaluation of the course as a whole given nearer the conclusion of the course, 55% strongly agreed or agreed that "recommended texts and/or instructional methods were effective in promoting my learning" (mean rating 2.55, SD 0.16, n=65). Differences in sample size and administration do not allow direct comparison of these

ratings, but they do suggest that this instructional method was generally well-regarded.

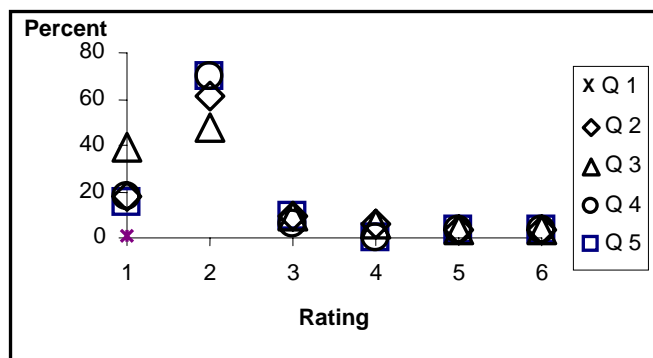


Figure 1. Ratings of students for instructional method using videotaped case.

Number of questionnaires returned was 33. Q1: “increased my knowledge of neurobiology”, Q2: “increased my motivation to learn neurobiology”, Q3: “increased my ability to apply neurobiology to clinical problems”, and Q4: “improved my understanding, motivation to learn, and/or ability to apply neurobiology more than a typical lecture”. Ratings were 1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = somewhat disagree, 5 = disagree, and 6 = strongly disagree; class size = 163.

To begin to address the value of the module for improving knowledge, understanding, retention, and transfer of knowledge, results for the four examination questions based on a clinical vignette that also required application of basic science knowledge to a cerebrovascular disorder at the cortical level, but not that same as the topic of the videotaped clinical case, shows that the percent of the class giving correct answers was 98%, 86%, 95%, and 100%, compared with 85% correct for the examination as a whole. Results suggest a possible positive value of the method for the goals of knowledge and understanding.

DISCUSSION

Guided discovery learning is a learner-centered approach that combines didactic instruction with more student-centered and task-based approaches. Studies in educational psychology of younger students suggest that it is superior to “pure” discovery learning with little or no guidance. In medical education, it also allows the problem-based approach to be incorporated into a lecture-based course for a larger class of students.

The example described here suggests that the clinical case presented by means of guided discovery learning serves to focus on real problems and adds relevance and motivation to mastery of related basic science information. In comparison to traditional lectures, it has the potential of greater involvement of the student in exploring the topic through self-directed learning reinforces understanding through

application to a real clinical problem provides role models for clinical application of basic science information, and provides an opportunity for synthesis and written expression. Preliminary results presented can be regarded as limited and anecdotal, but general agreement by students that this instructional method helps to focus on real problems and add relevance and motivation to mastery of related basic science information. In addition, examination questions based on a different clinical vignette that also required application of basic science knowledge to a cerebrovascular disorder at the cortical level suggests a possible positive value of this method for the goals of improving knowledge and understanding.

In comparison to problem-based learning in small groups, this instructional method has been less demanding on student and faculty time and less likely to reduce the time available for more traditional teaching modes. It has required sufficient preparation and collaboration between basic scientists and clinicians to produce a high-quality videotaped case, although the availability of similar internet-based case resources may make this component easier. It has also required faculty effort in reading and scoring written reports. This component presented at different times in small to medium sized groups, facilitated by neurology residents, and the class as a whole, facilitated by an experienced clinician-educator. Small groups provided more opportunity for student participation, but the uneven quality of instructors and difficulty in scheduling them was found to be a challenge.

Although PBL in small groups has often been contrasted with more conventional lecture-based learning (LBL) in medical education, variants of the PBL method have also been described for larger groups or combined with a lecture-based format. When a variant of the PBL method was applied in a medical biochemistry course to a larger group of students, student performance in a multiple-choice test did not show a significant difference between PBL and LBL, but PBL produced significantly higher student ratings in such areas as study time, enthusiasm, group discussion, and depth of knowledge.⁵ Methods of enhancing learner participation within a lecture format have been described that include clinical examples, questioning of students, recruiting students to solve “mystery cases”, and asking students to help summarize key points.⁶ The example described in this paper incorporated the methods of videotaped case presentations, self-study guides, class discussion, and written reports with the goal of providing the advantages of guided discovery learning in combination with an overall lecture-based format.

CONCLUSIONS

In conclusion, an instructional method using guided discovery learning with videotaped case presentation in a medical neurobiology course shows promise as a step to meet the objectives of improving motivation to learn neurobiology, understanding, retention, and transfer of knowledge, and application of basic sciences to a clinical

problem. Future research needs to be conducted with larger-scale evaluation of the effects of this method on both subjective student responses and objective performance.

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