

sample pages

Title	Teaching with Rich Learning Tasks: A Handbook
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Summary of Chapters and Appendices*

CHAPTER 1: OH RATS!**, examines the characteristics of rich learning tasks and what it is that makes them an essential part of learning.

CHAPTER 2: SIMON SAYS DO THIS**, examines the significance of learning for understanding, the ineffectiveness of rote learning, and the link between the former and rich learning tasks.

CHAPTER 3: BETTER BY DESIGN**, examines how structure can influence the richness of a learning task.

CHAPTER 4: WHY AM I DOING THIS?, examines the issue of relevance, what makes a learning task relevant, and why relevance is a critical issue in any learning task.

CHAPTER 5: HOW AM I DOING?, examines issues related to assessing student performance on rich learning tasks.

CHAPTER 6: HOW GOOD IS IT?, gives the teacher a tool for judging the richness of any learning task.

CHAPTER 7: RICH LEARNING TASKS ARE NOT ENOUGH, examines ten 'essential conditions for learning' that need to be in place in a classroom before students can meaningfully and productively engage in any learning task.

CHAPTER 8: WE NEED TASKS THAT SUPPORT SENSE MAKING, examines a pseudo-rich task from the perspective of how well it supports student sense making.

CHAPTER 9: WHERE DO A PROBLEM SOLVER'S PROBLEMS COME FROM?, examines the problem-generating role of rich learning tasks and the sense making/problem-solving cycle.

APPENDIX 1: SENSE MAKING***, examines the need to change the game played in the typical classroom and the key role rich learning tasks play in bringing this about.

APPENDIX 2: COMPARING THE GAMES WE PLAY IN THE CLASSROOM, compares the ubiquitous knowledge/acquisition game and the sense-making/action game.

APPENDIX 3: WHICH GAME ARE YOU PLAYING?, provides a tool to examine/modify teaching practices in order to better play the Sense-Making Game

APPENDIX 4: WHICH GAME ARE STUDENTS PLAYING IN THE CLASSROOM?, provides a tool to examine/modify student learning dispositions and habits in order to better play the Sense-Making Game.

APPENDIX 5: MOM, TUT, SENSE MAKING, AND RICH LEARNING TASKS, examines the three sense-making prerequisites, motivation, opportunity, and means.

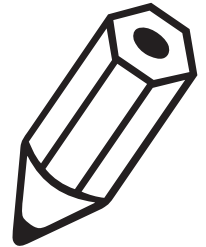
APPENDIX 6: AND THEY ALL LIVED HAPPILY EVER AFTER, equates sense-making with story-making.

APPENDIX 7: HOW CAN I USE THIS HANDBOOK?, contains practical suggestions, for people with different roles to play in education, on how to use this handbook.

APPENDIX 8: THE WORLD WIDE WEB, identifies a collection of web tools that should of particular interest to teachers who are looking for resources to support rich learning tasks.

APPENDIX 9: TOMORROW'S CLASSROOM LOGO, describes the four main elements of sense making, listing significant dimensions of these elements and aspects of these dimensions that influence, for better or worse, the student's opportunity to make sense.

APPENDIX 10: GIANT SHOULDERS, outlines the ideas that influence the perspective, attitudes, and beliefs of the authors of this Handbook.



* The sample learning tasks used in this handbook are mathematical in nature. Don't be concerned if you are 'non-mathematical'. You should have little trouble understanding the examples, seeing the cross-disciplinary pedagogical messages contained within them, and conjuring up equivalent learning tasks with which you are more familiar.

** Early versions of the first three chapters appeared in the Ontario Mathematics Gazette, June 98, December 98, and September 00.

*** This article first appeared in the Australian Mathematics Teacher journal, March 2002.

An Indictment of Rote Learning

In this chapter we examine two opposites, rote learning and learning for understanding and, in the process link learning for understanding with rich learning tasks.

Introduction

Rote learning occurs in both traditional and non-traditional classrooms. And, it occurs with worrisome frequency. I use the word ‘worrisome’ for the following reasons. Firstly, I claim that the phrase ‘rote learning’ is a pedagogical oxymoron. I also claim that rote learning ignores the needs of the learner, and that it is an ineffective way to learn. I further claim that rote learning impedes the learner from becoming a problem solver, that it is an anti-mathematical way of thinking, that it is a major source of anxiety, and that it is a form of (unintended) psychological abuse. In this chapter I attempt to justify these claims and, in the process, re-emphasise the importance of teaching for understanding.

Definition

When I say, ‘*by rote*’, I mean, ‘from memory, without thought of meaning, in a mechanical way.’

Some Beliefs About Rote Learning

Many think that rote learning has a significant role to play in the classroom. (‘Students often use rote learning as a kind of cognitive rest stop on the road to understanding.’ ‘Some things are best learned by rote.’ ‘It’s the only kind of learning some of my students can handle.’ ‘It’s great for training the memory.’) Many, less enthusiastic, others see rote learning as an expedient or ‘necessary evil’ used by teachers to ‘cover’ an overloaded course (‘I’d like to teach for understanding a lot more than I do, but I just don’t have the time in class to do it.’) Many students graduate believing that most (all?) mathematics, for example, is learned by rote and that learning has a whole lot to do with memorising, practicing, and regurgitating on request.

Students engage in futile lessons that attempt to teach difficult concepts in too short a time or in classes that substitute facts and vocabulary for understanding ...many educators continue to cover the content in books, and their students continue to memorise the related vocabulary and algorithms — an inefficient and ineffective mention-and-move-on instructional strategy. U.S. schools and colleges devote huge amounts of classroom time to reviewing and re-teaching the same material every year because students don’t learn it the first, second, or third time.

George Nelson, 2001

In mathematics you don’t understand things. You just get used to them.

*J. von Neumann
(1903–1957)*

An Example of Rote Learning

A teacher (in the form of a real person, a text page, writing on a computer monitor...) presents students with the formula for calculating the length of a line segment (see fig 1). (Little or no attention is given to the development of the formula or to the concepts underlying the formula.)

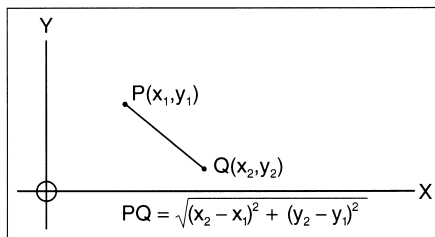


Fig. 1

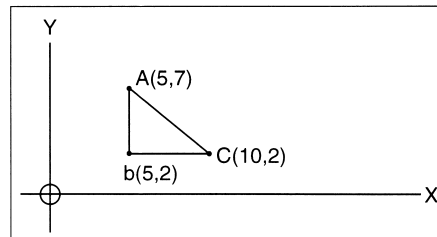


Fig. 2

Students are then walked through one or two sample problems to demonstrate how the formula is used.

Lastly, students are given a set of problems (like those in fig 2) to practice using the formula. Students ‘turn the crank’ and let the formula grind out the length AC, and then the length AB, and then the length BC, treating each problem in similar fashion, sometimes calculating a sum instead of a difference, sometimes forgetting to square a difference, sometimes forgetting to calculate a square root, accepting without concern answers for AB or BC that are (impossibly) greater than AC. On the practice goes, all without understanding the concepts underlying the procedure, all without thought to application, meaning, or reasonableness, all in a memorised mindlessly mechanical fashion.

An Example of Learning with Understanding

Students would have been better served in the above learning episode if they had first been given a well-designed series of fig. 2-type problems (preferably in some context) and asked the following question. ‘How might the Pythagoreans have solved such problems (assuming that they had a rudimentary understanding of a Cartesian coordinate system)?’

After working on this task, and discussing it with others, students could be asked to summarise their conclusions in the form of a general rule or formula. The end result would be the identical or equivalent formula that the teacher presented to students in the first example. This time, however, it would be the student’s formula, not the teacher’s. In addition, there would be understanding about such things as, the formula’s link to the Pythagorean theorem, when the formula need not be invoked, when an estimate would be sufficient, when signs would or would not be important, when square roots would and would not be needed, (perhaps) how the formula could be extended to handle 3D problems, etc. Many students would not even feel the need to commit the formula to memory. They would know the length formula as a simple variant of the good old Pythagorean theorem (bringing the appropriate form forward, as required, in different problem situations.)

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I recall once saying that when I had given the same lecture several times I couldn’t help feeling that they really ought to know it by now.

**J. E. Littlewood
(1885–1977)**

Learning with understanding is essential to enable students to solve the new kind of problems they will inevitably face in the future.

**National Council of
Teachers of Mathematics,
2000**

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Rich Learning Tasks and Learning with Understanding

A rich learning task (like the one above) is typically structured to give the learner the opportunity to engage in an inquiry, investigation, experiment, or problem-solving episode. It is through these processes that patterns are noticed, connections are made, ideas are built, meaning is constructed, sense is made, and understanding is achieved.

Comparing Rote Learning with Learning with Understanding

To me a rote-learning episode, like the first example given, feels like being introduced to a stranger, shaking hands, and then being obliged to engage the stranger in awkward small-talk. A learning-with-understanding episode, like the one in the second example, on the other hand, feels more like embracing an old friend and comfortably sharing (verbal) intimacies and reminiscences.

Students will continually encounter the unfamiliar, the uncomfortable, and the unknown in their studies. However, a learning-for-understanding episode will give students the opportunity to turn the unfamiliar into the familiar, the uncomfortable into the comfortable, and the unknown into the known. A rote-learning episode, a cognitive IOU from teacher to students, does not provide students with such an opportunity.

Rote Learning, an Oxymoron

Tom Kieren, recently retired educator and researcher at the University of Alberta, in conversation with the author in 1998, defined learning as, *'bringing forth a world of significance with others.'*

Consider the first six words of his definition. Before anything can be brought forth that has significance for the learner (or teacher), there needs to be personal understanding, connections made with the familiar, ownership, relevance, knowledge of where it comes from, where it fits, what it does, why it is important, why it works, how it works, what it leads to, its limitations, its forms and descriptions in words, images, and notations that are a part of the learner's repertoire. Rote learning, on the other hand, with its lack of concern for meaning, and with its emphasis on acceptance and the procedural, is not likely to bring forth from students anything more significant than questions like, 'Why am I doing this?' and 'What am I doing here?'

Now consider the last part of Tom's definition of learning. The two words, *'with others'*, suggests meaningful interaction. This includes such things as communication (in all its forms) to share, give feedback, encourage, explain, direct, make suggestions, justify, clarify, summarise, extend, and evaluate. With rote learning the interaction is far simpler and more direct. The teacher gives and the student receives. The teacher presents and the learner (happily, meekly, or grudgingly) accepts. The teacher (Simon) says 'do this' and the student (hopefully) obeys. The teacher pours and the warm-blooded vessel (supposedly) fills.

Understanding — the way the world stands forth for you, at that time.

Tom Kieren

(in conversation with the author, May 26, 2002.)

Ensuring that knowledge and skills are meaningful requires engaging the imagination in the process of learning.

Kieran Egan, 1992