

# Learning the Language of the Universe: How to Study Math

Melissa Gardenghi, M.Ed., M.S., Ph.D.

Chair, Division of Mathematical Sciences  
Bob Jones University

# Traditional Method

- review the lesson, watch the video, etc.
- look over the examples worked in the text (only if you know mom/dad/teacher is going to ask)
- do homework problems (as quickly as humanly possible)
- repeat for several lessons
- maybe try some sort of chapter review/chapter test (if you're an over-achiever),
- take a test (usually with questions almost identical to the homework)
- Result:
  - if you "get" math: success (ish)
  - if you don't: utter frustration, doom, gloom, and despair
    - ... then repeat with the advice to spend more time or do more problems

Better Solution  
... but first

adjust expectations to avoid frustration



Better Solution  
... but first

Adjust  
Expectations  
for your  
student

- Learning:
  - is HARD work
  - takes mental concentration/intense focus
  - is a skill
- Task completion is NOT the goal: understanding the ideas is
  - Review lesson/listen to lectures/etc.
  - Create study notes – explanations in “English”
  - Work problems to develop accuracy and increase speed

Better Solution  
... but first

Adjust  
Expectations  
for you

- Plan to stand firm against resistance
- Plan to rehearse your goals with your student
- Push your student towards improvement, not perfection

Acknowledge  
the balance ...



The Dream: heights of success and  
mastery of all things  
(aka your children happily  
asking for more homework)

Reality: it's hard work and  
nothing makes sense  
(aka moments of "grrrr")



# Study Effectively ....

means learning the right stuff

Understand what math is and is not ... so we can actually be sure we know what success is

- it **is a process** by which a variety of problems are solved
  - always show your entire process of thinking
  - one line per logical step, working down a sheet of paper
- it **is not a numerical answer**

Traditions are  
great for a  
reason ...

but some  
traditions can be  
improved on.





# Some traditions can be improved on ...

- Revision to the agenda
  - read/watch
  - work many problems
  - take a test
- Consider
  - read/watch – but with a new purpose
  - create study notes (1/2 to 1 page per topic – no longer)
  - work problems (possibly not as many)
  - have an oral quiz/teaching session
  - take a test (recommend timed, speed and accuracy both matter)

# Math Study Notes ...

create  $\frac{1}{2}$  to 1  
page notes for  
each lesson

- A descriptive title in 3-8 words
- Include the “theory” - what are important definitions, formulas, relationships
- Identify the types of problems that will be solved using these ideas
  - Work out an example problem
  - How can you recognize problems that are solved this way

If you can't talk in English without using “mathy” words,  
then you don't really understand what you are saying.

[Sample Study Notes](#)

Ahh, but are  
the study  
notes any  
good?

Like any skill it  
takes practice

Can they solve a problem by following the step by step instructions written in their notes?

- First use the notes to resolve an example
- Then use the notes on a “new” homework problem
- Then try it without the notes

Now that the notes are good, how can we “help” our student learn to use them?

Make your first response, “and how can our study notes help us?”

- “Did your study notes not help you solve that problem?”
- If they say “they didn’t help at all,” then ask them
  - Which page of your study notes will help you with this problem?
  - At which step in your notes did you get stuck?
  - What should we add to your notes to help you figure this question out in the future?

# How to “help” without diminishing actual learning

- Resist the temptation to eliminate the struggle
- Value mistakes, encourage perseverance and resilience
- Don't give answers to questions they ask, instead ask questions, such as
  - Can you find a similar example in the book/online?
  - Can you show me the same place in the example that you are getting stuck in your problem?
  - What was the next step in the example? How would it look in your problem?
  - Now that you've figured it out, what should you add to your study notes so that you can remember what you figured out?

Study  
Efficiently ....

means not  
being stuck  
doing  
something  
longer than  
necessary



OR



Study  
Efficiently ....

math needs  
good focus

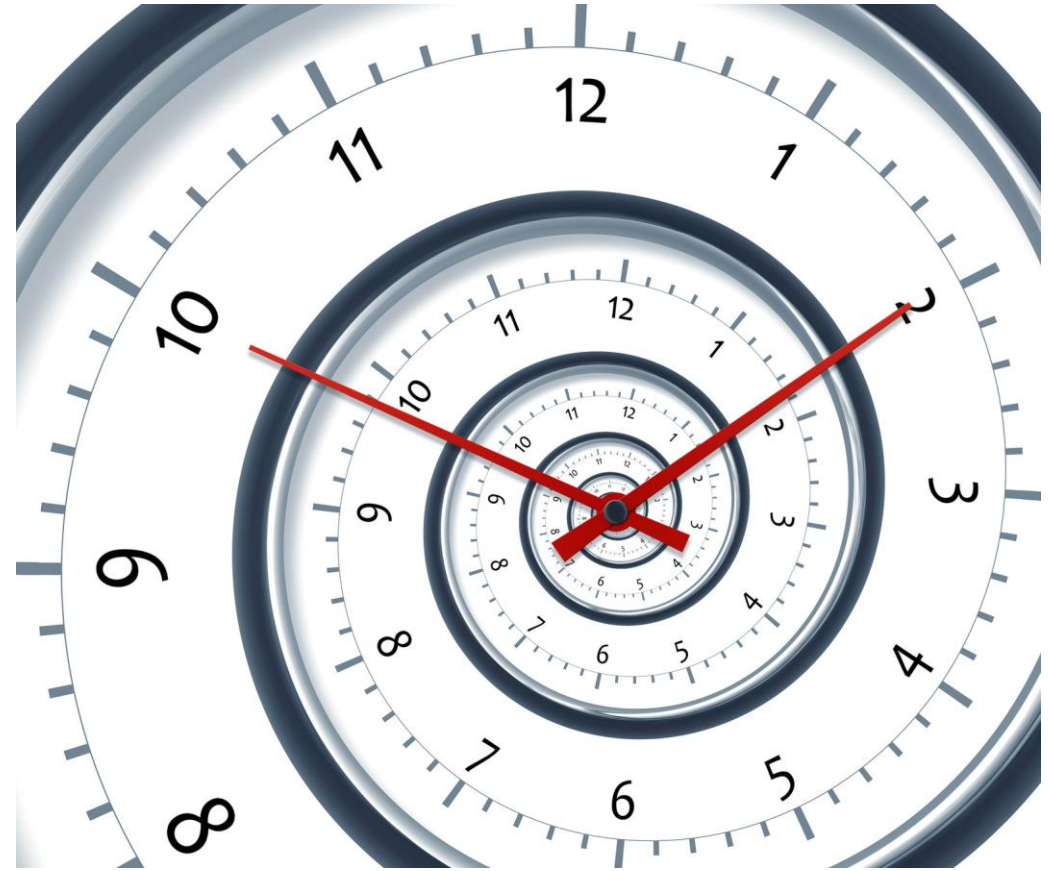
Count “quality hours” not clock hours

quality hours = clock hours \* % of concentration



Study  
Efficiently ....

Develop comfort with a time-pressured environment





Study  
Efficiently ....

don't let the  
"opportunity"  
to learn it  
"again" slow  
you down

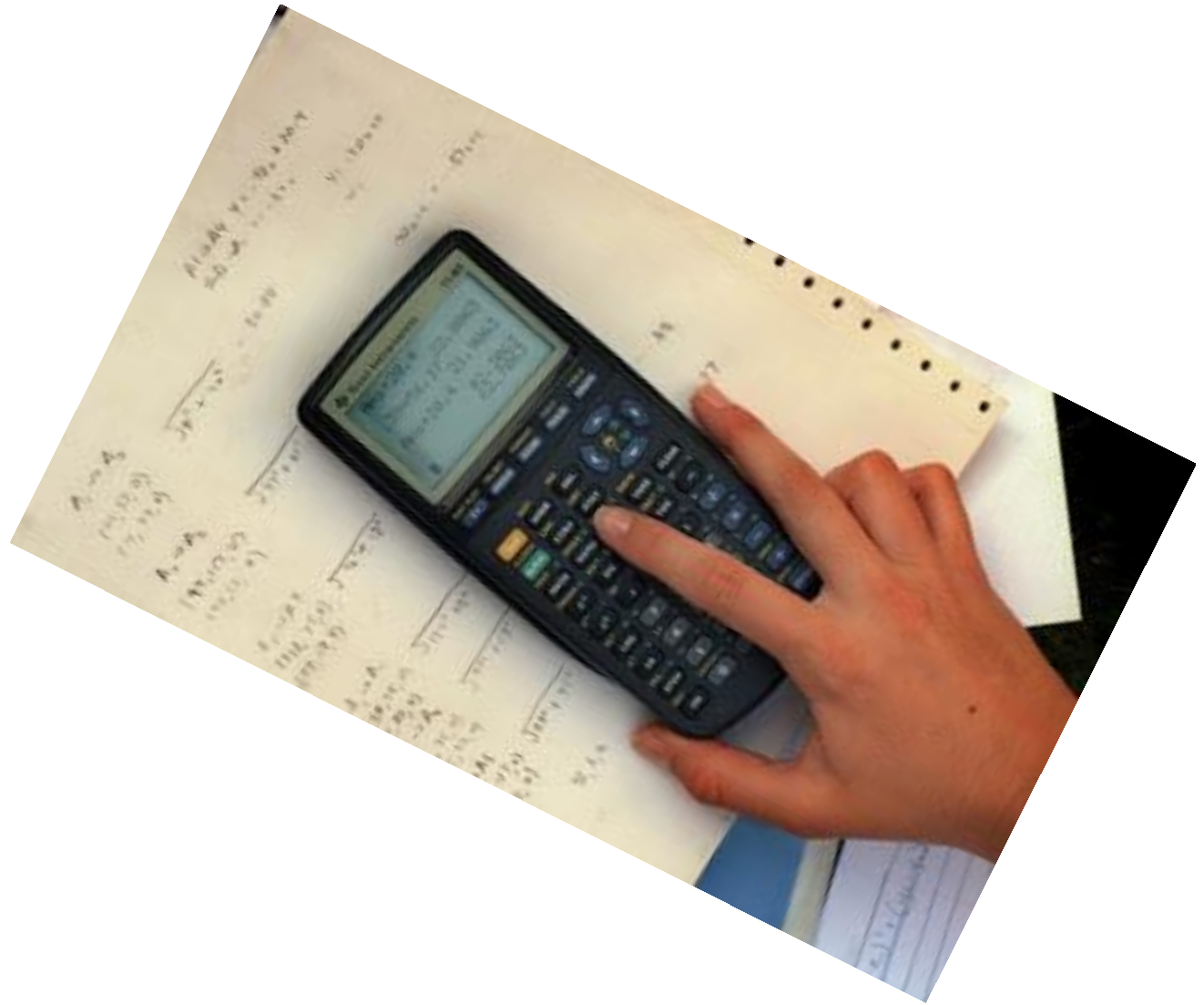
Let grades reflect actual  
understanding:

- don't let them see solutions until they've tried stuff
  - find a similar example in the book/online and see if they can mimic it
- don't let them correct answers after the fact for credit
- don't give access to solutions during the testing period



Study  
Efficiently ....

math needs  
freedom from  
bondage to  
calculators



Study  
Efficiently ....

develop more  
than one skill  
at a time



Develop critical reading/writing/communications skills by better learning math

- can you describe the characteristics of the problems that will use this solution technique
- can you make a bulleted list that will tell how to solve any similar problem (and can you follow these directions to solve problems)
- can you teach someone else how to solve the problem



Allocate your  
math time well

.... fast is slow

Before “starting the homework:”

- take 5 minutes and test understanding by having them “teach”
- explain each step in “normal English” ... no “mathy” language
- ask them, “how was I supposed to know to do it that way?”
- pick a problem, and only do exactly what they tell you to do

# Allocate your math time well

Use homework problems effectively –

There are two ways to learn something:

1. blind repetition (this can take forever) or
  2. purposeful learning with enough repetition to be confident, fast, and accurate
- If your student has “taught” you their math lesson, then assign just enough homework so that they are fast and accurate
    - Perhaps require them to complete \_\_\_ of each “type” of homework problem within a \_\_\_\_ minute time period correctly before they can be done

Reward understanding, problem mastery,  
and computational speed/accuracy

NOT task completion