

Making a Study Plan and Effective Study Techniques (Learning how to learn)

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About me

- BSc (Hons) (UBolton) in Civil Engineering, 1981
- PhD (Manitoba) in Statistical Hydrology, 1988
- Professor of Civil Engineering
- Discipline Chair of Civil Engineering (3 terms)
- Associate Dean (Graduate Studies) since 2010
- PEGNL Teaching Award 2001
- President's Award for Distinguished Teaching 2003
- Certified Level II Squash coach since 2007
- Ex-Certified Taoist Tai Chi Instructor
- Inventor of the Footworker, DOE-Golfer, DOE-SIM (app), DOE-SIM Pro (app), and Golfer (app)
- Two kids (3 Masters degrees between them)
- Research: Statistical hydrology, environmental statistics, design of experiments, and pedagogy.





Introduction



- Studying is a skill that can be learned and needs to be taught.
- This talk is about learning how to learn effectively - critical to academic performance.
- Proven effective techniques that promote long-term retention of knowledge will be introduced.
- Techniques are based on my personal experience, and on extensive recent research by cognitive scientists and educational psychologists.
- Techniques learned will be useful for students, teachers, and academic advisors.
- Techniques learned can be used for all situations –term tests, final exams, comprehensive exams, etc.



This talk will present



- ✓ Proven technique for planning your study
- ✓ Proven effective study techniques (how to study)
- ✓ Proven ineffective techniques
- ✓ Proven effective note-taking technique and
- ✓ Useful tip for changing mind-set for better understanding and retention
- ✓ Useful teachings tips to enhance understanding and retention

Making a Study Plan



- Technique is based on “distributed practice”. Study in small blocks of time spread over a certain period of time (interval).
- As opposed to “cramming” or “en masse”– studying over large blocks of time just before exams.
- Recent research (Eich, 2011; Dunlosky et al, 2013; Brown et al, 2014) has shown that “distributed practice” is the best method to retain what you have studied.
- I have used this technique since 1969, my kids have used it, and I have “saved” many students with this technique.
- You know when and what to study ahead of time – less anxiety, better retention, no panic and no need for “burning the midnight oil”.



You can get a good deal from rehearsal,
If it just has the proper dispersal.
You would just be an ass
to do it en masse:
Your remembering would turn out
much worsal – Eich (2011)

Distributed Practice Concept

Basic Rules



1. keep each study session to a maximum of 1.5 hours;
2. take a 15 min break between sessions. Go for a walk, get fresh air;
3. stick to the plan for a week, and then adjust if needed;
4. don't study on Friday evenings, Saturday or Sunday mornings (keep them as spare);
5. don't let homework distract from your study sessions; and
6. plan for homework separately (use free slots during the day).

Steps in Planning



- List all courses you need to study e.g. Anatomy, Botany, Classics (A, B, C);
- Decide which course requires more time and which less. E.g. A requires most time, and C requires least time. Assume ratios of 3:2:1. So A requires 3 times as much time as C, and B requires twice as much time as C.
- Do an inventory of study slots that you have for the week. Each study slot is 1.5 hours with a 15 min break. If you start at 7 pm each day, you have 7-8:30, 8:45-10:15, 10:30-12. That's 3 study slots per day. From Monday to Thursday, that will give 12 slots.

Steps (Continued)



- On weekends, you can start at 1 pm. So 1-2:30, 2:45-4:15, 4:30-6. Start after dinner at 8 pm. 8-9:30, 9:45-11:15. Same on Sunday. 10 slots on weekends. Total study slots = 22.
- Do your homework whenever you have free time before supper time, Monday to Friday if you can. Make use of time in between classes.
- Now you need to distribute 22 slots in proportion to required time for 3 courses. $\frac{3}{6} \times 22 = 11$ slots for A, $\frac{2}{6} \times 22 = 7$ slots for B, and 4 slots for C. You can always do adjustment like 10 for A, 8 for B, and 4 for C.
- Spread out courses and avoid doing back to back studying of the same course.

Steps (Continued)



- One possible plan is: Monday - A, B, A; Tuesday - C, B, A; Wednesday - A, B, A; Thursday - C, B, A; Saturday - C, B, A; B, A; Sunday - B, C, A; B, A. [10 A, 8 B, 4 C]
- Decide what to study for each session. Be specific e.g. topic, chapter #, or paper to read, etc.
- Try it for a week. Stick to schedule religiously. If you can do it just for a week, it will give you a great sense of satisfaction and achievement. Reward yourself on Friday night and sleep in on the weekends.
- If you need more time slots before exams, you can make use of the mornings on the weekends.
- You probably don't need them if you start weeks before exams. Work backwards to see when you need to start.

Steps (Continued)



- Make a calendar on a weekly basis with dates and times, course and topic to study. Take notes on points that are not clear and need to ask prof, etc.)
- Review the same topics/chapters sometime later to help retention.
- Longer intervals are generally more effective. Study sessions should be spaced about 10 to 20 percent of the retention interval.
- If you want to retain for 2 weeks, learning intervals should be 1.5 day to 3 days. For 5 years, interval is every 6 to 12 months.

Sample study plan

Week of September 21 - 27, 2015

Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Weekend times
	<p>Find free slots during school hours for homework or review of class notes.</p> <p>Review notes before and after classes as soon as you can</p>					Free time	Free time	
						Lunch	Lunch	
						C - Topic 2	B - Review	1 - 2:30 pm
						B - Chapter 2	C - Review	2:45 - 4:15
						A - Chapter 3	A - Chapter 4	4:30 - 6:00
6:00 PM	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	
7:00-8:30	A - Chapter 1	C - Topic 1	A - Chapter 2	C - Review 1	Free night	B - Chapter 2	B - Chapter 3	8 - 9:30
8:45 - 10:15	B - Basics	B - Basics	B - Chapter 1	B - Chapter 1		A - Chapter 3	A - Chapter 4	9:45 - 11:15
10:30 - 12 am	A - Chapter 1	A - Chapter 2	A - Chapter 2	A - Review 1 +2				

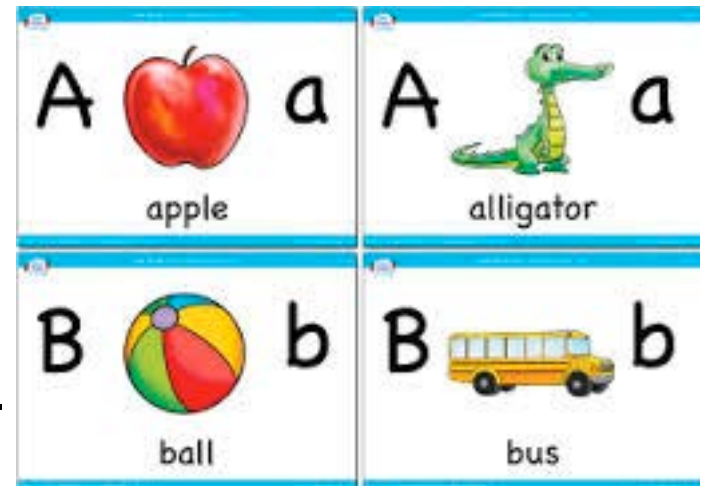
Some general advice



- You need to discipline yourself but don't be too ambitious.
- Start schedule in 2nd or 3rd week of class so that there is stuff to study.
- Don't be discouraged by minor setbacks. You can always make adjustments.
- When it is time for a break, really take a break.
- Use effective techniques to study and don't get distracted.
- There is quite a lot of time available in a week.
- Critical that you know exactly how much time or how many time slots you have in a week and how to make best use of these slots.

Effective Studying Techniques

- Dunlosky et al (2013) and Brown et al (2014) found **distributed practice** and **self-testing** are the two most effective techniques for learning and retention.
- Students can self-test with flash cards (physical or digital) to test recall or answering sample questions at end of chapter.
- Get a study partner to quiz you.
- Use Cornell note-taking system for in-class or study notes. Create questions to ask yourself using this system.
- See handout for Cornell note-taking system.



Cornell Note Taking System

(For Lecture or Reading)

Taking good notes is one of several keys to academic success. There are several reasons why developing an effective technique of note taking is important.

Reasons for Developing Effective Note Taking Techniques



1. Prevents forgetting:

Our memory fades quickly. For most students, forgetting occurs very rapidly after listening to a lecture, or reading over informational material even if the material is engaging and interesting. After lectures, for example, research shows that we forget 50% of what we hear within an hour and more than 70% within two days.

2. Encourages concentration:

Taking effective notes requires a student to be mentally active during a lecture or while reading. One has to pay attention, interact with information, make decisions about what to record, and write. Given that the mind is occupied with a demanding task, there is less opportunity for the mind to wander.

3. Records testable material:

Instructors generally expect students to remember and apply facts and ideas presented in lecture or in texts. Tests are based on key ideas teachers emphasize in their lectures and/or written material that supports key concepts or themes. In other words, the testable material.

Cornell Note Taking: The Process

Introduction

There are a variety of note taking styles. No single method suits all students. However, many successful students and business people have found that the Cornell note taking system is very effective for lectures or reading that is organized around clearly defined topics, subtopics, and supporting details.

The Cornell System is both **a note taking** and **a study system**. There are **six steps** to it.

Step One: **Record**

- 1) **Prepare your notepaper** by creating a two-column table. The left-hand column should take up about 1/3 of your writing space, leaving the remaining 2/3 for recording information. Use only one side of each sheet of notepaper.
- 2) **Summarize and paraphrase** (restate in your own words) the facts and ideas presented. **Record** definitions as stated or written.
- 3) **Indicate changes in topic** with headings or by leaving a space between topics
- 4) **Number, indent, or bullet** key ideas presented with each topic.
- 5) Aim for **telegraphic (brief) sentences, abbreviations, and symbols**. This will increase your note taking speed.
- 6) **Write legibly** so your notes make sense to you later.
- 7) **Edit** as soon as possible.

Step two: **Question**

Formulate **test questions** based on the information recorded in notes and write them in the **recall clues** column on the left-hand side of notes. Questions should focus on specific definitions and “big ideas”.

Cornell Note Taking: The Process

Step three: **Recite**

- 1) **Recitation** means explaining the information in the notes out loud, in your own words. The information should be triggered by the test questions in the **recall clues** column.
- 2) **Purposes of recitation:**
 - a. **Improves learning:** Psychologists who study how the memory works say that reciting aloud is a powerful technique for anchoring information in the long-term memory.
 - b. **Ensures understanding:** Reciting requires you to think about and understand the information you are committing to memory.
 - c. **Facilitates retrieval:** Understanding information improves your ability to retrieve it from your memory. Studies show that students who recite tend to do better on tests than students who just read their notes silently to themselves.
- 3) **Step in recitation:**
 - a. **Cover up** the notes in the “record” column or fold notes back along line separating the “clues” from the “record” column.
 - b. **Use recall clues** to stimulate your memory and **recite** the relevant information.
 - c. **Check your answers.** This gives you immediate feedback on how well you have learned and are able to retrieve the information. If you have difficulty recalling the information or if your answers are incorrect, learn and recite over again.

Step Four: **Reflect**

- 1) Reflection has to do with thinking about the information you are learning.
- 2) One way to reflect is to look for connections with your own experiences and observations and with other facts and ideas discussed in class.
- 3) Another way to reflect is to ask questions like: How do the main ideas fit together into a “bigger picture”? How do these ideas fit in with what I have already learned? What do I agree with? What do I disagree with? Which ideas are clear? Which are confusing? What new questions do I have?

Cornell Note Taking: The Process

Step Five: **Recapitulate** (summarize)

- 1) Write a summary of the main ideas using your own words. This is the best test of how well you understand the information.
- 2) Use a section at the bottom of each sheet of notes to write your summary or write a summary of all the notes on the last page of your note sheets.

Step Six: **Review**

- 1) A good guideline is to review nightly or several times during the week by reciting, not rereading.
- 2) Frequent, brief review sessions aid more complete comprehension of the material than cramming the night before a quiz/test.

Cornell Note Taking: Format

Recall Clues	Record
<p>Write recall questions here.</p>	<ul style="list-style-type: none">▪ Record notes here▪ Remember to focus on testable information<ul style="list-style-type: none">○ “big ideas”○ definitions○ supporting details▪ Bullet each piece of new information and skip lines to visually organize notes
<p>Summary:</p> <p>Write a summary of notes recorded on each page in this section of your notes... Or, create this section on the last page of your notes only, and summarize all information there.</p>	

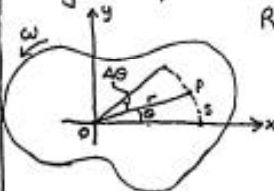
Examples of the Cornell Notetaking System

Example of the Cornell Notetaking System

<p>How do psychologists account for remembering?</p> <p>What's a "memory trace"?</p> <p>What are the three memory systems?</p> <p>How long does sensory memory retain information?</p> <p>How is information transferred to STM?</p> <p>What are the retention times of STM?</p> <p>What's the capacity of the STM?</p> <p>How to hold information in STM?</p> <p>What are the retention times of LTM?</p> <p>What are the six ways to transfer information from STM to LTM?</p>	<p>Psych.105-Prof.Martin-Sept.14 (Mon.)</p> <p>MEMORY</p> <p>Memory tricky-Can recall instantly many trivial things of childhood; yet, forget things recently worked hard to learn & retain.</p> <p>Memory Trace</p> <ul style="list-style-type: none"> - Fact that we retain information means that some change was made in the brain. - Change called "memory trace." - "Trace" probably a molecular arrangement similar to molecular changes in a magnetic recording tape. <p>Three memory systems: sensory, short-term, long-term.</p> <ul style="list-style-type: none"> - Sensory (lasts one second) <ul style="list-style-type: none"> Ex. Words or numbers sent to brain by sight (visual image) start to disintegrate within a few tenths of a second & gone in one full second, unless quickly transferred to S-T memory by verbal repetition. - Short-term memory [STM] (lasts 30 seconds) <ul style="list-style-type: none"> • Experiments show: a syllable of 3 letters remembered 50% of the time after 3 seconds. Totally forgotten end of 30 seconds. • S-T memory-limited capacity-holds average of 7 items. • More than 7 items--jettisons some to make room. • To hold items in STM, must rehearse-- must hear <u>sound</u> of words internally or externally. - Long-Term memory [LTM] (lasts a lifetime or short time). <ul style="list-style-type: none"> • Transfer fact or idea by: <ol style="list-style-type: none"> (1) <u>Associating</u> w/information already in LTM (2) <u>Organizing</u> information into meaningful units (3) <u>Understanding</u> by comparing & making relationships. (4) <u>Frameworking</u>-fit pieces in like in a jigsaw puzzle. (5) <u>Reorganizing</u>-combing new & old into a new unit. (6) <u>Rehearsing</u>-allow to keep memory trace strong
	<p>Three kinds of memory systems are sensory, which retains information for about one second; short-term, which retains for a maximum of thirty seconds; and long-term, which varies from a lifetime of retention to a relatively short time.</p> <p>The six ways (activities) to transfer information to the long-term memory are: associating, organizing, understanding, frameworking, reorganizing and rehearsing.</p>

- What is the equation for angular displacement?
- What are the units of angular displacement?
- What does s represent?

Review of Rotational Kinematics
 Rotational Motion of Rigid Objects
angular displacement

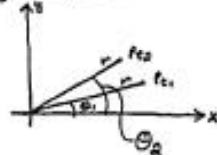


Rigid Object rotating about fixed axis O in z -direction

- $\Theta = 0$, when \vec{r} is along x -axis
- $\Theta > 0$, CCW rotation
- $\Theta = s/r$, where s is arc length
- $[\Theta] = \text{radians}$
- $\Delta\Theta = \text{angular displacement}$

- What is the eq'n for average ang. speed?
- What is the eq'n for instantaneous ang. speed?

angular speed



- avg. angular speed
 $\bar{\omega} = \frac{\Theta_2 - \Theta_1}{t_2 - t_1}$
- instantaneous ang. speed,
 $\omega = \frac{d\Theta}{dt}$
- $\omega > 0$, Θ increasing in CCW direction
- $[\omega] = \text{rad/s}$

- How do we define instantaneous angular acceleration?

angular acceleration

- avg. ang. acc., $\bar{\alpha} = \frac{\omega_2 - \omega_1}{t_2 - t_1}$
- inst. ang. acc., $\alpha = \frac{d\omega}{dt}$ $[\alpha] = \text{rad/s}^2$
- $\alpha > 0$, ω increases w/ time
- $\alpha < 0$, ω decreases w/ time

Angular displacement is $\Delta\Theta$, where $\Theta = s/r = \text{arc length}/\text{radius}$
 $[\Theta] = \text{radians}$
 Angular velocity is ω , where $\omega = \frac{d\Theta}{dt} = \frac{\text{change in displacement (angular)}}{\text{change in time}}$
 $[\omega] = \text{rad/s}$
 Angular acceleration is α , where $\alpha = \frac{d\omega}{dt} = \frac{\text{change in angular speed}}{\text{change in time}}$
 $[\alpha] = \text{rad/s}^2$

Ineffective Techniques

- Two of the most popular methods that don't work are **highlighting** and **rereading**.
- But, when highlighting is followed up by turning highlighted text into flash cards for self-testing, then it is more effective. Otherwise it is not recommended.
- Rereading fares poorly against more active techniques such as practice testing or self-explanation.
- Other techniques such elaborative interrogation (constantly asking why?), self-explanation, and interleaved practice (mix and match problems) are effective only on certain subjects and don't always work.

Useful Tips for Students



- Study with intention of teaching subject to someone else.
- Will change the way you study because now the focus is on a deeper understanding of the material.
- Think of what questions you will be asked.
- This simple change in mindset is very effective.

- If you are pressed for time, first read the questions at the end of the chapter before reading the chapter.
- Find the answers to the questions while reading the chapter.
- Your mind will now be more focused because you are now reading with a purpose.

Useful Tips for Teachers



- Provide lots of problem sets to students to practice on
- Quiz during class – at start of class, at end of class, after teaching a concept, etc.
- Quick multiple choice quizzes would suffice
- Provide quick feedback – see low cost “clicker”.
- Weekly or bi-weekly quizzes
- Encourage proper note-taking techniques
- Teach students how to plan their study and use of effective study techniques.

Low-cost “clicker”

Answer card - Folded



<p>A</p>	<p>C</p>
<p>B</p>	<p>Name: _____ Course: _____</p> <ol style="list-style-type: none">1. _____2. _____3. _____4. _____5. _____6. _____7. _____8. _____9. _____10. _____11. _____12. _____13. _____14. _____

Mehta (1995)

Example of instant assessment



Oil ($\rho = 0.85$) with a kinematic viscosity of $6 \times 10^{-4} \text{ m}^2/\text{s}$ flows in a 15-cm pipe at a rate of $0.02 \text{ m}^3/\text{s}$.

a) The Reynold's number is:

A. 2830 B. 283 C. 874

b) The head loss per 100 m of length of pipe is:

A. 9.83 m B. 3.90 m C. 98.3 m

Summary



Some study methods work in many different situations and across topics, boosting test performance and long-term retention. Learning how to learn can have lifelong benefits.

Self-testing and spreading out study sessions (distributed practice) are proven ways to improve learning. They are efficient, easy to use, and effective.

Underlining and rereading, two methods that many students use, are ineffective and can be time-consuming.

Other learning techniques need further testing and evaluation. In the meantime, students and teachers should use proved study methods in classrooms and at home.

Lastly,



- Study in small chunks, study consistently, and constantly test yourself.
- Get a good sleep, reward yourself, and exercise regularly.
- Work hard, play hard, eat well, and sleep well.

- You need to make some sacrifices!
- But if you plan ahead, you need not feel guilty.

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Techniques investigated



1. Elaborative interrogation - ✓
2. Self-explanation – ✓
3. Summarization – ✓
4. Highlighting/underlining - ✗
5. Keyword mnemonic - ✗
6. Imagery for text - ✗
7. Rereading - ✗
8. Practice or self-testing - ✓
9. Distributed practice - ✓
10. Interleaved practice - ✓

Questions/Discussions