The internet changed information from being a scarce resource, the value being in having it, to making information
easily accessible 24/7 and the value being in able to select and apply specific information as needed.

“In this age of information overload and abundance, those who get ahead will be the folks who figure out
what to leave out, so they can concentrate on what’s important to them.” (Austin Kleon)

“The ability to learn faster than your competitors, may be the only sustainable advantage in the future.”
(Arie De Geus, Dutch Royal Shell executive)

Practicing “just in time” learning (e.g., I’ll look it up when I need it) doesn’t work well against competition because
the more someone has learned previously, the further down the track they’re starting and the faster they’ll run
through new material. Most important, continually investing in learning information has a compounding payback.

Hence, Edison’s quote: “Genius is one percent inspiration and ninety-nine percent perspiration.” When facing new
material, those who have invested the perspiration start well ahead of those who haven’t. So how does one
maximize their return on this perspiration?

Questions to consider:

● What new knowledge and skills offer the best return on investment for my future circumstances?
● How well do I need to learn these compared to my competition? Compared to the best at this?
● Do I have or can I generate sufficient motivation to achieve success? To meet my goals?
● By what process do I best learn these? In what venue (e.g., traditional classes, MOOC’s, self-directed)?
● What learning resources are available? Which are best?
● How do I trust or evaluate the validity of a learning resource? The credibility of an expert?
● How do I evaluate my learning? Reinforce my retention?
● How do I avoid being misled by my own biases and cognitive weaknesses?
● What investment of time and money is likely required? How can I obtain or schedule these?
● What is the payoff? What are the risks? Is this the best investment of these scarce resources?

Background:

Success requires three steps - recognizing opportunities quicker than one’s competition, making better decisions
than one’s competition, and executing more effectively than one’s competition. All three require skills and
knowledge, much general but some specific to the circumstances. Given the constantly changing physical,
economic, political, social, and technological environments, to stay at the top of our game we must constantly be
learning new skills and knowledge. To achieve and to maintain competitiveness, we must be life-long learners.

Prior to the Internet providing 24/7 information access, information was a limiting resource. Obtaining a “corner”
on that scarce resource required one to be in the physical presence of an instructor who determined the course
content, selected the course materials, established a logical sequence, delivered the material in the form of
passive lectures, paced enrollees through the course materials with reading assignments, graded problem sets,
popped quizzes, gave summative tests, and provided performance feedback. With the emergence of the Internet,
information for learning new skills and knowledge is readily and widely available to anyone. The advantage goes
to those who are the quickest at identifying, evaluating, acquiring, and learning from the best information
resources. Developing the best question to drive learning is an important skill that students usually don’t develop
in traditional teacher-driven learning. Those answering the best questions are more successful than those
obtaining the best answers to flawed questions. By enabling global access to learning resources, digital
technology has increased both the number competing and the level of that competition.

For everyone, time is a constantly passing, fixed, limited resource that like money can either be invested for future
returns or spent. Time can invested in learning for long term recall or spent on binging and purging to get over the
hurdle of the next test. While academic institutions care about grades and reward those with high ones, most employers and clients don’t; they simply want their problem(s) solved quickly and effectively. Time is now the limiting resource, making efficient strategies for identifying learning resources and executing learning processes critical.

Finally, the most important step is using the new knowledge to start doing the new activity, whatever it is, or changing behavior. Be honest with yourself to make sure that learning without any doing isn’t really a cover for procrastination or inaction stemming from fear. In the end, only doing really counts.

1. **Optimize Your Learning Processes**:
   - **Critical**: Although we’ve constantly learned since infancy, empirical research shows that we fail to optimize our learning processes through personal experience or trial and error.
   - Evidence-based materials on optimizing learning practices
   - Thalheimer W (2013). *The Decisive Dozen*: Research background abridged - [pdf](#) (esp. training employees)
   - Organizing Instruction and Study to Improve Student Learning (note - intended for teachers at all levels, even self-teachers, recommended by [DT Willingham](#) - [articles](#) - [blog](#))
   - Appreciate your natural, ingrained cognitive biases and adopt practices to counter them - [wiki](#) [wiki](#)

2. **Define Your Intrinsic Motivation**:
   - A resilient source of motivation is absolutely critical to maintaining sufficient drive to achieve success when facing the necessary repetition, practice and self-testing that good learning requires
   - 15 ways of the successful self-directed learner - [Mission to Learn](#)
   - Scott Geller - The psychology of self-motivation - [YouTube](#)
   - Daniel Pink - Motivation - [YouTube](#) - Autonomy / Mastery / Purpose - [Drive](#) - [review](#)
   - Heighten your curiosity by identifying your knowledge gaps and relentlessly asking strong “why?” questions
   - Specific curiosity correlates with both motivation and learning - [pdf](#) [pdf](#) [html](#) [html](#)
   - Anticipate peaks and valleys in confidence and motivation
   - Forecasting confidence levels with the bipolar learning graph - [diplateevo](#) 1/4/03

3. **Identify What to Learn**:
   - Identifying what you don’t know and developing key questions with which to delve into it are critical skills. For many things, we remain in a state of unconscious competence, sometimes to our detriment. Then an event moves us to awareness or conscious incompetence. Has somebody somewhere likely figured out a solution to a similar problem? Have books likely been written about this? Courses taught that cover it? Did it evolve from something you’ve learned previously? Has anyone assembled a literacy guide to the fundamental concepts?
   - Four stages of competence - [wiki](#)
   - Five things you didn’t know about lifelong learning - [The Knewton Blog](#)
   - How to learn what you don’t know - [LifeHack](#)
   - Construct a clearly stated, answerable key, essential question and subsidiary questions to drive focused learning efforts, revising these as your understanding develops. Incorporate specific vocabulary. Identify underlying key concepts, and processes.
   - Quora wiki - what are the questions that people don’t ask themselves enough? - [html](#)
   - Questions that promote deeper thinking - [aspx](#)
   - Asking the right questions: A guide to critical thinking, 8th ed - [pdf](#) 11th ed - [Amazon](#)
   - Every discipline has an underlying set of core concepts and processes identified with a specific vocabulary or lexicon. Different disciplines use different terms to identify what are often similar underlying concepts or [memes](#). An essential first step is identifying these concepts and their associated vocabulary, which are often covered in special glossaries intended for learners new to the topic.
   - wisdom - [wiki](#)
● Construct a concept map linking these core concepts that evolves as your knowledge of the underlying structure develops - concept map (mind map)
● Develop systems thinking. Identify system components, their linkages, and the system dynamics
● To identify B2B business opportunities, do a SWOT analysis of up to two steps prior to and two beyond the target system (suppliers to the suppliers of your business and buyers from the buyers from your business).
● Identify the trade press, academic journals, conferences, organizations, and online media (e.g., blogs, websites) targeting audiences involved in a discipline or activity and scan these for vocabulary and concepts specific to the discipline or activity. Identify the key authors and speakers contributing to these and google their on-line papers, posts, presentations, and proceedings. - doc
● Academic librarians provide tools to assist learner with this initial step and introductory courses often include glossaries in course notes or in the textbook. Key words or phrases often have location-dependent synonyms, plurals, and variant spellings.

4. Identify How Much to Learn:
● General steps: Naming > defining > classifying > explaining
● Identify certifying or credentialing organizations for the applicable skill and obtain their lists of suggested study materials and learning objectives. Most training programs are regularly evaluated by an external group; ask those running a relevant program who. Some examples:
  ○ ARPAS - American Registry of Professional Animal Scientists - study guides
  ○ Board Certification:
    ■ American Board of Veterinary Practitioners - 2009 self study guide - pdf
    ■ American College of Theriogenologists - 2015 pdf
    ■ European College of Bovine Health Management - ECBHM - recommended readings
    ■ Royal College of Surgeons Certificate in Cattle Health and Production - pdf
● Identify content and time (credits) of core domain courses in applicable BS and MS degree curriculums
● Consider intended application of understanding, superficial to deep:
  ○ awareness of fundamental concepts and associated key vocabulary of the archetypical systems in the domain
  ○ identify specialized terminology associated with fundamental concepts sufficiently to identify learning materials
  ○ understand the dynamics the system archetypes; their constraints, flows, links, and feedbacks
  ○ understand the associated procedures, protocols, and processes
  ○ aware of problems potentially associated archetype systems
  ○ when working within a specific system be able to:
    ■ detect problems using general or previously established procedures
    ■ resolve routine problems
    ■ train employees in general procedures to operate and monitor the specific system
    ■ adapt procedures to the specific system
    ■ resolve non-routine problems
    ■ develop new procedures for the system
    ■ develop new systems
    ■ explain current circumstances impacting a system
    ■ predict future circumstances impacting a system

5. Find What to Learn With:
● Using the key questions from step 3, use focused, structured procedures to methodically:
  ○ Identify and obtain review papers, review journals, and papers in an annual review series from a subscribing library
  ○ Search Internet for online glossaries containing key vocabulary and wikis introducing key concepts and links to further materials
  ○ Find applicable course syllabi online that identifies learning resources - Google likely course names and include "syllabus" and "pdf."
● Identify several applicable introductory textbooks containing fundamental concepts and terminology
● Identify experts presenting on topic at conferences or writing articles and search for online pdf’s of articles they’ve authored
● Identify relevant MOOC’s - massive open online courses - wiki
● Use the suggested reading list for the relevant professional board exam
● Form a learning group among like-minded peers
- Contact discipline experts for recommendations, particularly to identify other experts
- Carefully filter sources; the digital age enables any author to assume credentials, to claim expertise and experience, to publish their ideas, and to broadcast their works widely
  - [Evaluating Internet Resources](#)
  - [Is it scholarly?](#)

6. **Undertake Learning Process:**
  - **Deconstruction:** Break down broad, amorphous goals into linked components with discrete metrics. Invest time in deconstructing how the very competent experts do what they do. What are the anomalies? How do those who get spectacular results do so; what do they do differently? What do the top 10 do? Compared to the rest, what don’t they do? Apply 10 to 15 questions. Zero in on the best practices. Are there reverse practices? How do those who learn the quickest in the beginning do so? What are the minimum learnable units, the LEGO blocks, to start with? Identify the failure points, the barriers, the reasons people quit, and the learning “slow downs” in the learning sequence and innovate around them to succeed for at least five sessions. Question everything. Question the obvious. Question best practices. Take a realistic inventory of your relevant strengths and weaknesses. Identify why you might fail before you start. Identify and separate the skills.
  - **Selection (Minimalism):** 80/20 analysis - which 20% of the blocks are core to achieving 80% or more of the outcome I want? Solve for the extremes and you solve the mean. Key is applying the Pareto Rule 80/20 rule to everything - activities, clients, contributors, products, services, and eliminating the non-overlapping, low returning. Find the elegance, simplify to the extent possible. What is the MED (minimum effective dose) of learning or practice per session? Compared to conventional methods, what should I not be spending time on? What will I adhere to and what won’t I adhere to? What are the best feedback tools, mechanisms, and methods? What are the best self-evaluation tools? The Axis of Awesome 4 chords - [wiki](#)
  - **Sequencing:** The secret sauce - early wins. What is no stakes, no risk? What is the least amount necessary to feel that you are winning? What is the best order in which to learn the blocks? Opposite order? Backwards? Learning the opposite and the reverse can improve fluidity and efficiency more quickly. What makes it winnable? Establish concrete steps. Establish two week comparison tests based on quantifiable data. Learning under pressure and risk is the worse time vs. learning and practicing under no pressure, no risk. What are the roadblocks that lead people to quit learning or practicing a new skill? What behavioral change is needed for success? What behavioral change do people fail at? What am I going to do and what am I not going to do? What are the non-negotiables that are constraints? Following the principle of not tackling more than one skill at a time, what sequence of skills should I learn? Learning is being adaptable, learning quickly is being creative and doing the non-obvious.
  - **Stakes (Incentive, Motivation):** How do I set up stakes to create real consequences and guarantee I follow the program to achieve behavioral change? Have a margin of safety so that some good comes even if things go badly. Loss of money is a great incentive. [http://www.stickk.com/](http://www.stickk.com/) Establishing stakes and a referee raise compliance from <20% to >70%. Consequences.
  - **Compression (Simplify, Focus):** Try to remove things first. Can I encapsulate the most important 20% into an easily graspable one-page? What is the minimal effective dose? Simplify - the overlying principle is to simplify, to remove things first before adding. The Little Prince - “Perfection is achieved not when there is nothing more to add but when there is nothing more to take away.” Focus on removal. The biggest mistake is trying to do too much at once.
  - **Frequency:** How frequently should I practice? Can I cram, and what should my schedule look like? What growing pains can I predict? What is the minimum effective dose (MED) for volume? What equipment is required for the initial MED? No stakes practice of skills that transfer vs. practicing under time pressure.
  - **Encoding:** How do I anchor the new material to what I already know for rapid recall? DiSSSS and CaFE are examples of encoding. Reflect on the process.
  - blogs:
    - Lifehacker - deconstruct the skills you want to learn to make learning faster - 5/13/13
    - TNW Talks - Tim Ferriss shares how to master any skill by deconstructing it - 5/12/13
  - wiki:
    - [Michel Thomas](#) - [Michel Thomas method](#) - language learning
The Axis of Awesome - 4 chords

- Rapid skill acquisition checklist (pg. 27 in: Josh Kaufman, The First 20 Hours: How to learn anything fast, 2013 - detail in book) - TED Talk, YouTube
  - Choose a lovable project - focusing on prime (most lovable) skill acquires it in the least time
  - Focus your energy on one skill at a time - acquiring new skills requires a critical mass of concentrated time and focused attention
  - Define your target performance level - single sentence specific description of what you’re trying to achieve and what you’ll be able to do when you’re done
  - Deconstruct the global skill into specific sub-skills and identify the key ones to practice first
  - Obtain critical tools
  - Eliminate barriers to practice:
    - significant pre-practice effort (setup) needed
    - intermittent resource availability
    - environment distractions
    - emotional blocks
  - Make dedicated time for practice - “finding” time is a myth; nobody “finds” time for anything
  - Create fast feedback loops - get accurate information on how well you’re performing as quickly as possible
  - Practice by the clock in short bursts - set a countdown timer for 20 min, 4 sets for 1.5 hr max
  - Emphasize quantity and speed after establishing “good enough” form
  - Pre commit the time to invest in practicing for at least 20 hours in place of other activities and to push through early ego-crushing frustration
  - Decide, Deconstruct skills, Research just enough, Eliminate emotional barriers to practice, Pre-commit to practicing at least 20 hours

- Ten principles of effective learning (pg. 27 in: Josh Kaufman, The First 20 Hours: How to learn anything fast, 2013 - detail in book)
  - Research the skill and related topics -
    - Spend 20 minutes web searching, bookstore browsing, or library stack scanning to identify 3 books, instructional DVDs, or courses connected to the skill
    - Quickly identify the most important sub-skills, critical components, and required practice tools
    - Quickly collect wide knowledge about the skill and gain a view of the skill acquisition process
  - Jump in over your head - if you’re not confused by half of your early research, feeling intimidated or hesitant, you aren’t learning as quickly as you’re capable of
  - Identify mental models and mental hooks
  - Imagine the opposite of what you want
  - Talk to elite practitioners to set specific goals, outcomes, expectations, or target performance levels
  - Eliminate distractions from your environment
  - Use spaced repetition and reinforcement for memorization, sleeping within 4 hours for consolidation
  - Create scaffolds and checklists
  - Make and test predictions
  - Honor your biology
  - blogs:
    - Good Life Project - Accelerated learning: How to get good at anything in 20 hours - 6/26/13

7. Repeated self-testing enhances retention

- Repeated testing enhances retention more than repeated practice
  - Test-enhanced learning - pdf
  - Test-enhanced learning: The potential for testing to promote greater learning in undergraduate science courses - html

8. Evaluate your depth of understanding

- Test yourself for “Illusion of Explanatory Depth” (IOED), be careful of the Dunning-Kruger effect, and avoid naive realism
  - The “illusion of explanatory depth”: How much do we know about what we know? Scienceblogs
11/16/06
Do you know what you don’t know? HBR Blog 5/3/12
Dunning-Kruger effect - wiki - counter more
ICBS Everywhere - 6/9/10
Learn difficult concepts with the ADEPT method - Better Explained
naive realism - wiki
"The Feynman Technique"; google ‘Feynman Technique blank paper’ to find descriptions, Scott Young pdf YouTube
See Chap 4: Understanding how things work, pgs. 89-119 in: Smart Thinking: Three essential keys to solve problems, innovate, and get things done, 2012 A Markman or The Five Elements of Effective Thinking, 2012 EB Burger, M Starbird
An excellent method to detect IOED is to explain or teach it to someone. The principle is that if you can’t explain it, you don’t know it well enough and while explaining it, new questions will occur to both the teacher and the learner

Other Materials:

○ IHMC CMap Tools
  ■ Constructing your first concept map - html

○ Mindtools - learning skills:
  ■ Affinity maps
  ■ Concept maps
  ■ Mind mapping
  ■ Rootcause analysis
  ■ Systems diagrams

○ The Critical Thinking Community
  ■ The Miniature Guide to the Art of Asking Essential Questions

● books:
  ○ Smart Thinking: Three essential keys to solve problems, innovate, and get things done, 2012 - A Markman (KC2MM) - Amazon
    Most important are the discussions of IOED (illusion of explanatory depth) and teaching yourself in Chap. 4: Understanding How Things Work.

  ○ The 5 Elements of Effective Thinking, 2012, Burger, EB, M Starbird - Amazon
    Note the “blank document” method of discovering one’s knowledge gaps (p. 21)

  ○ A Mind for Numbers: How to excel at math and science (even if you flunked algebra), 2014, B Oakely - Amazon
  ○ O’Reilly Head First book series - Head First formula
  ○ A More Beautiful Question: The power of inquiry to spark breakthrough ideas, W Berger - book website - Amazon
  ○ Feynman’s Tips on Physics: Reflections, advice, insights, practice, a problem-solving supplement to the Feynman lectures on physics, 2013, RP Feynman, MA Gottlieb, R Leighton - Amazon
  ○ Guesstimation 2.0: Solving today's problems on the back of a napkin, 2012, L Weinstein, P Edwards - Amazon
  ○ How Many Licks? Or, how to estimate damn near anything, 2009, A Santos - Amazon
  ○ How to Measure Anything: Finding the value of intangibles in business, 3rd ed., 2014, DW Hubbard -
- Amazon
  - Power Questions: Build relationships, win new business, influence others 2012, A Sobel, J Panas - Amazon
  - Smart Questions: Learn to ask the right questions for powerful results, G Nadler, W Chandon - Amazon
  - STOP • THINK • CREATE: 42 things you must stop doing immediately so you can start to think more creatively, Warren Berger - pdf
  - Street-fighting Mathematics: The art of educated guessing and opportunistic problem solving, 2010, S Mahajan - Amazon - MIT open course second version - text draft pdf - TEDxCalTech
  - Fermi Problems in physics
  - chap 4 in Concepts in Engineering: Problem Solving - pdf
  - chap 5 in Teaching Engineering: Problem Solving and Creativity - pdf

- blogs and other online materials:
  - SXSW: Acquiring the skill of meta learning - Tim Ferriss at SXSWi
    - Have optimism
    - Have baselines - understand your strengths and weaknesses
    - Replicate outliers and anomalies
    - DSSS
      - Deconstruction - deconstruct how the best do what they do; break skills down into pieces, then ask “Why have I failed at this skill, or why might I fail?” and innovate to avoid the failure points
      - Selection - Use as little effort and as few tools as possible and be good at these; 80% of the return comes from the core 20% of the effort and the tools - The Axis of Awesome 4 Chords video
      - Sequencing - Switching learning order to oppose or reverse improves fluency and efficiency. The worst time to learn a skill is when you need it; instead model it outside of the pressure of application. Flip dried beans in cold skillet while watching TV rather than the omelette
      - Stakes - Give yourself real stakes
      - Simplify - Focus on 1 or 2 to-do’s; Antoine de Saint-Exupery - “Perfection is achieved, not when there is nothing more to add, but when there is nothing left to take away”
  - LiteMind
    - Einstein’s Secret to Amazing Problem Solving (and 10 Specific Ways You Can Use It)
    - 10 Best Ways to Harness the Power of Questions
  - Forbes
    - Three (incredibly simple) questions the most successful people use to change the world - 8/21/12
      - 1) What’s the outcome I want?, 2) What stands in my way?, 3) Who has figured it out already?
    - The best question to ask really smart people so you can learn from them - 7/9/13
      - “If you were me, what questions would you be asking?”
  - LessWrong (a community blog devoted to refining the art of human rationality)
    - Fermi Estimates
  - New & Improved
    - To properly solve the problem, ask the right question
  - US News
    - 18 Problem Solving Questions - 10/14/10
  - New & Improved:
    - To properly solve the problem, ask the right question
  - Pragmatic Marketing
    - Problem Solving: It's all about smart(er) questions
  - RQI - Right Question Institute
    - Establish a question focus about the topic or issue
    - Write down as many questions about the question focus without judging, answering or editing
    - Convert any statements to questions
    - Convert some open ended questions to close ended, and visa versa
    - Prioritize the list of questions
    - Explain the rationale for the order of the highest ranking questions
    - Improve the highest ranking three to five questions
    - Determine how to use the highest ranking questions
    - First, produce questions - Four essential rules for generating questions
- Think of as many questions on the topic as you can
- Don’t stop to consider, discuss, judge, or answer the questions
- Write down every question
- Change any statement into a question

**Then improve your questions**
- Categorize the questions as closed- or open-ended
- Consider the advantages and disadvantages of each question type
- Change questions from one type to another

**Prioritize the Questions**
- Choose your three most important questions.
- Consider why these are the three most important

**Next Step**
- How are you going to use your questions?
  - Stanford Design Bootcamp
  - Bootcamp bootleg - [pdf](#)
  - Study Guides and Strategies
    - Problem Solving and Decision Making
  - [Warren Berger](#)
    - How to cultivate the art of asking good questions
    - Before you abandon those resolutions, read this
  - FastCompany - [Design - Warren Berger](#)
    - Scared Of Failing? Ask yourself these 6 fear-killing questions - [html](#)
    - Find your passion with these 8 thought-provoking questions - [html](#)
    - Tackle any problem with these 3 questions - [html](#)
  - Wicked Problems: Problems worth solving, Jon Kolko, ac4d - [Table of Contents](#)

- wiki:
  - 5 Whys
  - analytical hierarchy process
  - causal thinking
  - causality
  - creative problem solving
  - complex systems
  - cognitive bias
  - cognitive load
  - concept map
  - creativity
  - critically thinking
  - design thinking
  - dimensional analysis
  - Dunning-Kruger effect
  - Eight disciplines problem solving
  - Fermi problems
  - Five W's
  - GROW model
  - How to solve it
  - ignorance management
  - information ecology
  - inquiry-based learning
  - knowledge ecosystems
  - knowledge integration map
  - knowledge management
  - lateral thinking
  - list of concept and mindmapping software
  - memorization
  - mental model
  - mind map
  - morphological analysis
  - naive realism
  - PDCA - W Edwards Deming WA Shewhart
  - practice (learning method)
- problem solving
- rational planning model
- Robert M. Gagne - designing instruction
- root cause analysis
- rote learning
- schema
- scientific method
- six thinking hats (Edward de Bono)
- Socratic questioning
- skepticism
- study skills
- systems thinking
- unified structured inventive thinking
- why-because analysis
- words per minute - **Note**: slide presentations are typically given at 100 wpm, audio books 150-160 wpm; adults read prose text at 250-300 wpm => reading is 2-3x faster
- worked example effect
- prospect theory
- wicked problem