How does one optimize learning and thinking processes to minimize time investment but maximize return?

"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

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. Time is now the limiting resource, making using 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. Understand Optimal Human Learning Processes:
   - Critical: Although we’ve constantly learned since infancy, empirical research shows that without understanding the learning process, we fail to optimize it through personal experience or trial and error.
   - Appreciate natural, ingrained cognitive biases - wiki wiki list

2. Identify Source and Degree of Motivation:
   - An adequate, resilient source of sufficient motivation is absolutely critical to maintaining sufficient drive to achieve success
     - 15 ways of the successful self-directed learner - Mission to Learn - html
   - Heighten curiosity by identifying 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:
   - 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. Identifying and developing key questions is a critical skill.
   - Identify underlying key concepts, and processes. 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.
   - 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 - [pdf](#)
  - European College of Bovine Health Management - [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

- websites:
  - Modified Bloom’s Learning Objective Taxonomy - [pdf](#)

- wiki:
  - [Bloom’s Taxonomy](#) of learning objectives

5. Find What to Learn it 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 on-line 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 on-line pdf’s of articles they’ve authored
  - Identify relevant MOOC’s - massive open on-line 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](#)
6. ** Undertake the 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 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/ 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? DISSS and CaFE are examples of encoding. Reflect on the process.

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**blogs:**
- Lifehacker - deconstruct the skills you want to learn to make learning faster - 5/13/13
- TNWTalks - Tim Ferriss shares how to master any skill by deconstructing it - 5/12/13
- Rise to the Top - Tim Ferriss interview - How to become world class in anything in 6 months or less
- Minimalism example - The Axis of Awesome - Book Small Giants - bo Burlingham (Amazon)

**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
  ○ Precommit 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. Evaluate sufficiency of understanding

● Eliminate “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
Other advice:

**LessWrong**: (“a community blog devoted to refining the art of human rationality”)

- Scholarship: How to do it efficiently - [5/9/11](#)

**Sources:**

- book series:
  - for Dummies
  - Idiot's Guides
  - O'Reilly:
    - Cookbooks - [html](#)
    - Head First Labs books - [html](#)
    - In a Nutshell books - [html](#)

**Optimizing Learning Processes:**

Just as research has shown that individuals are unable to consciously optimize their own happiness, evidence shows that we are unable to optimize our individual learning processes based on our personal experience.

Suggested evidence-based reading on how to optimize our individual learning practices:

- papers:
  - **Pdf links may require a WSU logon.** Many papers are also available through the linked author’s website.
    - Thalheimer W (2013). The Decisive Dozen: Research background abridged - [pdf](#)

- websites:
  - [Organizing Instruction and Study to Improve Student Learning](#) (note - intended for teachers at all levels, recommended by DT Willingham - [articles](#) - [blog](#))
  - [IHMC CMap Tools](#)
    - Constructing your first concept map - [html](#)
  - [Learning Strategies](#)
    - Beat the Forgetting Curve - [pdf](#)
  - [Mindtools](#) - learning skills:
    - [Affinity maps](#)
    - [Concept maps](#)
- Systems diagrams
  - Self-made Scholar
    - Getting started - html
    - The best of SelfMadeScholar - html
      - Great thinkers on self-education - Socrates - html
      - How to learn on your own: Creating an independent scholar resource plan - html
    - Self-education resource list - html
  - The Critical Thinking Community
    - The Miniature Guide to the Art of Asking Essential Questions
  - The Socratic Method Research Portal
  - U Nebraska
    - CSI - cognitive strategy instruction - html
  - The Writing Center (George Mason U)
    - How to write a research question - html
- 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
    - Learning How to Learn: Powerful mental tools to help you master tough subjects, UC San Diego Coursera course - slides pdf
    - Learning how to learn - TEDx Oakland
    - 10 rules of good studying - pdf
    - Turning student groups into effective teams, J Student Centered Learning 2(1):9-34, 2004 - pdf
  - O'Reilly Head First book series - Head First formula
- articles:
  - Is listening to audiobooks really the same as reading? Forbes 9/12/11
  - DT Willingham U Virginia:
    - Practice makes perfect - by only if you practice beyond the point of perfection Am Educ spring 04
    - Why students think they understand - when they don't Am Educ winter 0304
    - How to help students see when their knowledge is superficial or incomplete - Am Educ winter 0304
      - the standard of "knowing" is the "ability to explain to others," not "understanding when explained by others."
  - What you can learn from author Tim Ferriss, the four-hour marketer, Ad Age - 1/21/13
- coursera
Learning How to Learn: Powerful mental tools to help you master tough subjects
- Dr. Barbara Oakley, U Oakland - [website](#)
- A Mind for Numbers: How to excel at math and science (even if you flunked algebra) - [Amazon](#)
- Dr. Terrence Sejnowski, UC San Diego

- blogs:
  - [BrainPickings](#), Maria Popova
    - Don’t go back to school: How to fuel the internal engine of learning - [5/13/13](#)
    - [Don’t Go Back to School](#): A handbook for learning anything - [Amazon](#)
    - 14 ways to acquire knowledge: A timeless guide from 1936 - [4/22/13](#)
    - [You Can Do Anything](#), James Mangan
  - [Dilbert blog](#) by Scott Adams
    - Career advice - [7/20/07](#)
  - [Farnam Street](#) (Shane Parrish)
    - The Buffett Formula - How to get smarter (read!)
    - [How to read a book](#)
    - Mental Models
  - [I Love Charts](#)
  - [Josh Kaufman](#)
    - Do you have these core human skills? - [7/20/09](#)
    - What must an educated person know? - [8/29/11](#)
  - [Lifehacker](#)
    - How I work - [series](#)
  - [Live Your Legend](#), Scott Dinsmore
    - The 27 principles to teaching yourself anything (aka The Self-Guided Education Manifesto + PDF download) - [12/14/11](#)
  - [Seth Godin - squidooHQ](#)
    - Stop Stealing Dreams (What is school for?) - [pdf](#) [screen](#)
  - [Sources of Insight](#)
    - Deliberate Practice - [9/22/14](#)
  - [SXSW](#) - Acquiring the skill of metalearning - [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 opposite 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 skilet while watching TV rather than the omllette
      - 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”

- [Quora](#): (requires registration to access)
  - How can I learn better and faster? - [html](#)
    - list of 67 Quora responses classified by 9 categories - [html](#)
  - How can you learn faster? - [html] [starred](#)
  - How can I better retain what I learn from reading (the encyclopedia)? - [html](#)
  - How can I improve my ability to explain things better? - [html](#)
  - How can I improve my ability to understand concepts intuitively? - [html](#)
  - Productivity: How can I increase my productivity? - [html] [starred](#)
  - How can I learn as much as possible in my life? - [html](#)
  - How can I truly learn from what I read? - [html](#)
- How can you increase your productivity on side projects at the end of the day when you’re tired from work/college? - [html starred]
- How does one become a better writer? - [html]
- Psychology: How do I overcome my hatred of studying even though I love learning? - [html]
- How do I retain what I learn? - [html]
- How do math geniuses understand extremely hard math concepts so quickly? - [html]
- Studies and Studying: How do top students study? - [html starred]
- How do you learn complex material quickly? - [html]
- How do you study to get an A in a difficult class? - [html starred]
- What are the best productivity tools for entrepreneurs? - [html starred]
- What are the best productivity tools for programmers? - [html starred]
- What are some brain hacks that a neuroscientist or psychologist knows that most people don’t know? - [html starred]
- What are some of the best studying techniques? - [html]
- What are the top 10 things that we should be informed about in life? - [html]
- What did Richard Feynman mean when he said “What I cannot create, I do not understand”? - [html]
- What is the best study method? - [html starred]
- What learning strategies do people who are “quick learners” follow? - [html starred]
- What test taking strategies do top students use? - [html starred]
- Why don’t college students ask question in class? - [html starred]

- wiki:
  - cognitive load - intrinsic (manage - break into subschemas), extraneous (reduce), germaine (increase - organizing schemas [mnemonics])
  - concept map
  - Dunning-Kruger effect
  - ignorance management
  - information ecology
  - inquiry-based learning
  - knowledge ecosystems
  - knowledge integration map
  - knowledge management
  - list of concept and mindmapping software
  - memorization
  - mental model
  - mind map
  - practice (learning method)
  - Robert M. Gagne - designing instruction
  - rote learning
  - schema
  - Socratic questioning
  - skepticism
  - study skills
  - 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

**Optimizing Thinking Processes:**

Because the information flows in our mind unavoidably involve our subconscious brain, sound rational thought is considerably more difficult and we are much more susceptible to cognitive biases than commonly appreciated. As a consequence of the inevitable involvement of our subconscious, thinking and acting without bias is impossible. Our only hope is to use disciplined thinking procedures that minimize bias; awareness alone is simply insufficient protection. For example, we use random generators to perform random selection or allocation because we cannot and we use “blinding” to reduce observational bias. Collectively we may approach rational behavior, such as in economics, but individually we cannot, leading to the emerging discipline of behavioral economics.
papers:
  - A practical guide to critical thinking, 2006, GR Haskins - pdf
  - Twenty tips for interpreting scientific claims, 2013, WJ Sutherland, D Spiegelhalter, MA Burgman, Nature 503:335-337 - pdf html
    - Six more practical pointers - Nature 504:376 - pdf html
books:
websites
  - Center for Critical Thinking
  - IQ Matrix - the big picture
    - Becoming a better critical thinker - html
    - How to become a big thinker - html
  - Scientific Methods (on-line book) - pdf
  - The well-built question - html
lists:
  - Critical thinking & analysis guide, 2008 - pdf
papers:
  - Isaac Asimov mulls “how do people get new ideas?” - MIT Technology Review 10/20/14
blogs:
  - I think : I design
    - Exploring design thinking - 7/24/14
  - Who you gonna believe, me or your own eyes? (Mark Crislip, Science-based Medicine 7/12/13)
wiki:
  - cognitive bias
  - creativity
  - critically thinking
  - design thinking
  - knowledge integration map
  - mind map
  - naive realism
  - prospect theory
  - scientific method
  - systems thinking

Optimizing Decision Processes:
Attention scarcity in era of information overload, affective ease, providing opportunity for relative judgement, order values on 3 to 9 cards

- papers:
  - Veterinary clinical decision-making: cognitive biases, external constraints, and strategies for improvement, 2014, B McKenzie JAVMA 244(3):271-276 - html skeptvet 1/22/14

- books:
  - Decisive: How to make better choices in life and work, 2013, C and D Heath - Amazon
    
    book website, workbook pdf, backmatter pdf -

- decision-making problems:
  - Narrow framing - tendency to define choices too narrowly, to see them as binary. Convert “Should I do this OR that?” to “Is there a way I can do this AND that?”. Need to search for new, better options
  - Confirmation bias - tendency to select information that supports prior attitudes, beliefs, and actions. Because information is being collected, confirmation bias looks “scientific.” Rather than seeking the truth, reassurance is being sought, which leads to reasonable conclusions being drawn from a distorted data pool. What’s typically in our spotlight is the most accessible information + our interpretation of that information but that is rarely all that we need to make a good decision
  - Short term emotion - feelings churn, same arguments are replayed in head, agonizing over circumstances, changing mid daily, but no new information is being added and what is needed is perspective. Denial, attacking data as wrong occurs.
  - Overconfidence - people think they know more than they do about how the future will unfold. The future has an uncanny ability to surprise and we have too much confidence in our predictions; we don’t know what we don’t know. Doctors “completely certain” about a diagnosis were wrong 40% of the time; students estimating they had only a 1% chance of being wrong were wrong 27% of the time.

- Solution - WRAP:
  - You encounter a choice but narrow framing makes you miss options
    > Widen your options - How can you expand your set of choices?
  - You analyze your options but confirmation bias leads to the gathering of self-serving information
    > Reality-test your assumptions - How can you get outside your head and collect information that you can trust?
  - You make a choice but short term emotion will tempt you to make the wrong one
    > Attain distance before deciding - How can you overcome short-term emotion and conflicted feelings to make the best choice? Emotional distancing - Ask yourself “How would you advise a friend in similar circumstances?”
  - Then you live with it but you’ll be overconfident about how the future will unfold
    > Prepare to be wrong - How can we plan for an uncertain future so that we give our decisions the best chance to succeed?

  - Risk Savvy: How to make good decisions, 2014, G Gigerenzer, Amazon - wiki

- courses:
  - Duke Decision class - BA925 J Payne - TED Talk
    - syllabus - html pdf
    - recommended books
- Harvard **MLD-304**: Science of Behavior Change - syllabus [pdf](#)
  - books:
- Stanford **Symbolic Systems 170/270**
- websites:
  - The Norms and Preferences Network
    - Chap 1: Decision theory and human behavior - [pdf](#)
- wiki:
  - analytical hierarchy process
  - decision making
  - Delphi method
  - naïve realism
  - pairwise comparison
  - prospect theory

**Optimizing Problem Solving:**

*It is a familiar and significant saying that a problem well put is half­solved.* [John Dewey](#)

*For every complex problem, there is a solution which is simple, neat, and wrong.* [HL Menecken](#)

- courses:
  - Rice Eng / Lead 545 Structured Problem Solving - [Arnaud Chevallier](#)
    - Powerful Problem Solving
    - slideshare - [Analytical Problem Solving](#)
    - syllabus - 2014, 2013
  - U Cambridge
    - Research skills course - Matthew Juniper - issue and hypothesis trees
  - U Kent
    - problem solving skills
  - U Mich
    - Strategies for creative problem solving - [html](#)
  - UW engineering
    - creativity - [pdf](#)
    - creative problem solving tools - [pdf](#)
- papers:
  - Building shared understanding of wicked problems - [pdf](#)
  - Design thinking, 2008 T Brown, HBR - [pdf](#)
How to ask a smart question, S Snyder - html
Innovation as defining and resolving wicked problems, O Mascarenhas ENT 470/570 - doc
Rethinking design thinking: Part I, Design and Culture 3(3), 2011 - html
Strategy as a wicked problem, JC Camillus, HBR, 2008 - html
Tackling Wicked Problems - pdf
Understanding complex systems, AW Hubler - pdf
Wicked problems, A Richardson, designmind - html
Wicked problems in design thinking, Design Issues VIII(2), 1992 - pdf

websites:

- Coaching for Change - Irene Leonard
  - The Art of Effective Questioning: Asking the right question for the desired result - pub10
  - reading list

- Fast Company
  - Design Thinking . . . What is that?

- IDEO

- Lifetime Reliability Analysis
  - Understanding how to use the 5-Whys for Root Cause Analysis - pdf

- LiteMind
  - Einstein’s Secret to Amazing Problem Solving (and 10 Specific Ways You Can Use It)

- McKinsey
  - Seven easy steps for problem solving at McKinsey - slide share

- Mindtools - problem solving techniques:
  - Root cause analysis

- 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

- 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

- books:
  - 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
  - Guessstimation 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
  - 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:
  - http://stanford.edu/~rhorn/a/kmap/mess/CmprngIlStrctrd7Tame.pdf
  - Clever workarounds
    - dialogue mapping
  - 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

quora (requires registration to access)

What are the best ways to think of ideas for a startup? - html - starred

wiki:

- 5 Whys
- analytical hierarchy process
- causal thinking
- causality
- creative problem solving
- complex systems
- design thinking
- dimensional analysis
- Eight disciplines problem solving
- Fermi problems
- Five W's
- GROW model
- How to solve it
- lateral thinking
- mind map
- morphological analysis
- PDCA - W Edwards Deming WA Shewhart
- problem solving
- rational planning model
- root cause analysis
- six thinking hats (Edward de Bono)
- systems thinking
- unified structured inventive thinking
- whyecause analysis
- wicked problem

Optimizing Self-directed Learning:

Self-directed learning requires replacing those functions performed by traditional curriculums, which include determining learning objectives and outcomes (what to learn? how well?), establishing an order and pathway through these (what order?), identifying and constructing learning resources (with what?), such as textbooks, course notes and lecture materials, to the support processes, pacing students through the material, constructing evaluation processes, such as quizzes and tests, and establishing performance standards (do I know it?). Conventional course syllabi may identify resources and provide some structure; these are often available on-line. In the absence of traditional course mechanics, the biggest challenges are driving oneself through the material and determining how well one has learned it.

papers:


Note the coverage of IOED by the two books above.

- Debunking the myth of the 10,000-hours rule: What it actually takes to reach genius-level excellence, brain pickings - html
- Explanation and understanding - http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3034737/
How long it takes to form a new habit, brain pickings. M Popova - html
What matters in scientific explanations: Effects of elaboration and content - http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3204176/
The effects of domain knowledge on metacomprehension accuracy - pdf
http://link.springer.com/article/10.1007/s11409-012-9093-0

websites:
- brain pickings
  - Isaac Asimov on science and creativity in education - html
- RQI - The Right Question Institute
  - Make Just One Change: Teach students to ask their own questions - Amazon
    - 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?
- Essential Questions: Opening doors to student understanding - Amazon
  - Open ended; no single, final, correct answer
  - Thought provoking
  - Require higher order thinking - analysis, inference, evaluation, prediction that can't be answered by recall alone
  - Point toward important, transferable ideas
  - Require support and justification, not just an answer
  - Recur over time

books:
- Don't Go Back to School: A handbook for learning anything, 2013 - Kio Stark, - Amazon
  - "How to be an independent learner" in pdf
  - Don't Go Back to School: How to Fuel the Internal Engine of Learning - brain pickings html
  - Scott Berkun review
- Four Hour Chef - Amazon
  - Tim Ferriss has his own questions turned against him! - Eventual Millionaire Jaime Tardy
- Maximize Your Potential: Grow your expertise, take bold risks & build an incredible career (The 99U book series), JK Glei, 99U - Amazon
- The First 20 Hours: How to learn anything . . . fast, 2013, J Kaufman - Amazon

Quora (requires registration to access)
- Learning New Things: What’s a cool/useful skill that only takes five minutes to learn? starred
- Skills: What are some skills that can be picked up in 10-minutes, 1-day, and 1-week? starred
Tips and Hacks for Everyday Life:

- What can I learn right now in just 10 minutes that could be useful for the rest of my life? starred
- What are strong indicators that someone new to a particular field has a lot of potential? starred
- What should we focus on learning in an age where almost all information is at your fingertips? html
  - Data -> information -> knowledge -> expertise -> execution
  - Access -> assimilate -> apply

blogs:

- How to become a designer without going to design school - html
- Is College for Everyone? 11 Alternatives to the Traditional 4-Year College - The Art of Manliness - 4/17/14
- Asking better and more beautiful questions - 3/12/14
- HBR
  - How to ask better questions - 5/6/09
  - Learn to ask better questions - 6/16/10
- Sources of Insight: Proven practices for personal effectiveness
  - The Six Filters for Truth - 6/5/14 (per Scott Adams “How to fail at almost everything and still win big”)
    1. Personal experience (Human perceptions are iffy.)
    2. Experience of people you know (Even more unreliable.)
    3. Experts (They work for money, not truth.)
    4. Scientific studies (Correlation is not causation.)
    5. Common sense (A good way to be mistaken with complete confidence.)
    6. Pattern recognition (Patterns, coincidence, and personal bias look alike)

wiki:

- autodidacticism (self-teaching)
- lifelong learning
- List of autodidacts

Understanding Complex Systems:

websites:

- USDOE Introduction to System Dynamics

courses:

- Scott E. Page, University of Michigan
  - Model Thinking - coursera
  - The Great Courses

papers:

- Doyle JK, DN Ford, MJ Radzicki, WS Trees. Mental models of dynamic systems - pdf
- Doyle JK, DN Ford. Mental models concepts for system dynamics research - pdf

blogs:

- The Oil Drum
  - Twenty (Important) concepts I wasn’t taught in business school - part I, Nate Hagens 9/20/13

Quora (requires registration to access)

- complex systems
- Anup Pydah response to Quora question:
Your focus when learning physics should NOT be learning the steps of a derivation, or the formulae, or any associated complicated math. It should be on trying to understand the behavior of the underlying phenomena.

1. **Visualize** the phenomena (a thought experiment/simulation)

2. **Ask** the same questions **every time** -
   - How do I characterize the behavior of this system? AKA what is this system doing? (For mechanics - the kinematics of the system)
   - What kind of interactions does this system encounter which can change its behavior? (Forces, torques etc.)
   - How do I relate the interactions with the behavior of the system? (The grand laws of physics-Newton’s et al)
   - What assumptions do I need to make/are made for the previous step? (THE MOST IMPORTANT QUESTION OF ALL)

3. **Check** if your newly derived equations make sense. (Sanity checks)

4. **Repeat. Re-analyse**. The more you do this, the more "feeling" you get for the behavior of physical phenomena.

- **wiki:**
  - complex systems
  - system dynamics
  - systematics - study of multi-term systems
  - systemography
  - systems engineering
  - systems thinking
  - wicked problems

**Optimizing Learning Communities:**

- **papers:**
  - How to build connections when you’re just starting out - 99U articles - [html](#)
  - How to build thriving online learning communities - [pdf](#) - Sloan Consortium
  - Professional learning communities: What are they and why are they important? - [pdf](#)

- **books:**
  - Better than College: How to build a successful life without a four year degree, 2012 B Boles
    - [www.ztcollege.com](#)

- **web**
  - SDSU - Learning together: Building learning communities - [html](#)

- **WSU**
  - 4H learning communities
  - Building successful learning communities handbook - [pdf](#)

- **wiki:**
  - brainstorming
  - Delphi method
  - prediction markets
  - professional learning community
  - wiki
Optimizing Other Factors Impacting Performance:

- **papers:**
  - Resistance to Change: Unconscious Knowledge and the Challenge of Unlearning, Richard E. Clark - pdf

- **books:**
  - Be Excellent at Anything: The four keys to transforming the way we work and live, 2010, T Schwartz, J Gomes, C McCarthy - Amazon
  - Finding Flow: The psychology of engagement with everyday life, 1997, M Csikszentmihalyi - Amazon
    - TED Talk - Flow, the secret to happiness
  - How to Fail at Almost Everything and Still Win Big: Kind of the story of my life, 2013, Scott Adams - Amazon
    - Less Wrong - review
  - Mindset: The new psychology of success, how we can learn to fulfil our potential, 2006, CS Dweck - Amazon
    - The Effort Effect
  - The First 20 Minutes: Surprising science reveals how we can exercise better, train smarter, live longer, 2012, G Reynolds - Amazon

- **websites:**
  - Angela Lee Duckworth - U Penn - Grit - research
    - TED Talk - The Key to Success? Grit - transcript
    - Big Questions On-line - Can perserverance be taught? - html
  - Cooking for Engineers
  - Lifehacker - How I Work
    - I'm Kathryn Minshew, CEO of the Muse, and this is how I work - 3/12/14
    - I'm Tim Ferriss, and this is how I work - 11/20/12
  - Nerd Fitness
  - Popular Mechanics - skills -
  - Sir Ken Robinson
    - TED Talk - How Schools Kill Creativity - transcript
    - TED Talk - Bring on the Learning Revolution! - transcript
    - TED Talk - How to Escape Education's Death Valley - transcript
  - Trevor Maber - Rethinking thinking - TED

- **quora:** (requires registration to access)
  - As a startup CEO, what is your favorite productivity hack? starred
  - How can a non-technical person best evaluate technical talent starred
  - If someone asked you to give them a random piece of advice, what would you say? starred
  - Motivation: How can I motivate myself to work hard? starred
  - The Internet: What are the most productive ways to spend time on the internet? starred
  - What can I start doing now that will help me a lot in about five years? starred
  - Want To Live With No Regrets? Follow These 43 Life Lessons -
  - What is some general advice for a new PhD student? - html
  - What qualities characterize a great PhD student? - html starred
  - What small lifestyle changes have the biggest impact? - html starred

- **blogs:**
  - Study Hacks: Decoding patterns of success - Cal Newport
    - The Grandmaster in the Corner Office: What the study of chess experts teaches us about building a
remarkable life - 1/6/10 Deliberate practice that is:
● Designed to improve performance
● Repeated a lot
● Feedback is continuously available
● Highly demanding mentally
● Hard
● Requires good goals

■ The Career Craftsman Manifesto - 8/11/11
■ Flow is the opiate of the mediocre: Advice on getting better from an accomplished piano player - 12/23/11
● Avoid flow - do what does not come easy
● To master a skill, master something harder
● Systematically eliminate weakness
● Create beauty, don’t avoid ugliness
○ Hire for the ability to GSD (get s**t done) - Elad blog - html
○ Metacognition And Learning: Strategies For Instructional Design - html
○ What is cognitive load? - html

● wiki:
  ○ cognitive load
  ○ flow (psychology)
  ○ grit (psychology)
  ○ knowledge market
  ○ metacognition

General Knowledge and Literacy:

● web:
  ○ linkedIn - If I were 22

● books:
  ○ 10 Things Employers Want You to Learn in College: The know-how you need to succeed - Amazon
    ■ list - pdf pdf

● quora: (requires registration to access)
  ○ How can one make the most of one’s youth? - html starred
  ○ What are a few unique pieces of career advice that nobody ever mentions? - html starred
  ○ What are important things and advice to know that people generally aren’t told about? - html starred
  ○ What are some great “must-watch” videos for entrepreneurs and startups? - html starred
  ○ What are some of the best examples of general career advice? - html starred
  ○ What are some skills that can be picked up in 10-minutes, 1-day and 1-week? - html starred
  ○ What are some things that neuroscientists know but most people don’t? - html starred
  ○ What are some must-know tricks of your trade that most people are oblivious to? - html starred
  ○ What are some useful computer related technical skills I can learn within a day? - html starred
  ○ What are the most awesome psychological facts? - html starred
  ○ What are the most important things one can learn in the course of life? - html starred related
  ○ What are the top 10 things that we should be informed about in life? - html starred
  ○ What are the things any working person should know about economics? - html
  ○ What can I learn right now in just 10 minutes that could be useful for the rest of my life? - html starred
  ○ What can I start doing now that will help me a lot in about five years? - html starred
  ○ What is the biggest misconception people have about life? - html starred
  ○ What’s the shrewdest, smartest maneuver you’ve ever seen in business? - html starred
  ○ What is the single greatest piece of career advice you’ve ever received? - html starred
  ○ What should everyone know about:
    ■ accounting? - html starred
- economics? - html starred
- food safety? - html starred
- investing? - html
- marketing? - html
- math? - html
- nutrition? - html
- science? - html
- writing? - html starred

Wisdom: What general wisdom do people in their 40s and 50s have to pass down to people in their 20s or 30s? - html starred

- wiki:
  - scientific literacy

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(Notes to self - other resources for potential incorporation):

- [http://research.moreheadstate.edu/content.php?pid=96934&sid=1112064](http://research.moreheadstate.edu/content.php?pid=96934&sid=1112064)
- [http://libguides.wsulibs.wsu.edu/content.php?pid=108535&sid=816706](http://libguides.wsulibs.wsu.edu/content.php?pid=108535&sid=816706)
- [http://info-skills.lib.vt.edu/developing_search/4.html](http://info-skills.lib.vt.edu/developing_search/4.html)
- [http://library.wur.nl/infoboard/4a_strategies/identifying.html](http://library.wur.nl/infoboard/4a_strategies/identifying.html)

From blog notes:

How to identify an expert:
- How to find an expert (and find one if you’re not) - Lifehack - html
- What gives you the right to tell me - - html
- When the expert needs and expert - - html
- So what makes you such an expert - - html
- How to identify a true expert - Separating the fakers from the true gurus - html
- How to identify a true subject matter expert - pdf
- How does a non-expert identify experts and important publications? - - html
- - - html
- - - html
- - - pdf

Mission to Learn
- 25 free online resources - 6/09
- 5 practices to prime accelerated learning - 10/29/13
- 15 ways of the successful self-directed learner - 10/8/13
- Learn with 10 ways to be a better learner - book chapters
- Definition of learning


Angela Duckworth - https://sites.sas.upenn.edu/duckworth
Angela Lee Duckworth: The key to success? Grit
http://www.ted.com/talks/angela_lee_duckworth_the_key_to_success_grit.html
Can perseverance be taught?
https://www.bigquestionsonline.com/content/can-perseverance-be-taught