

*Learning on Steroids:*

# Holistic Learning for Technical Subjects



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## Learning on Steroids:

# Holistic Learning for Technical Subjects

This implementation guide isn't about a specific tactic, rather it's about how you apply holistic learning and all the tactics you've learned so far to math, physics, computer science and other technical courses.

Technical courses provide both the greatest opportunity to use holistic learning and the biggest opportunity to waste time.

The opportunity for faster learning is great. Most people approach technical subjects from a highly rote fashion—true understanding isn't there, people just try to memorize formulas and solution patterns. Gaining a truly deep understanding can be a huge time saver over memorizing all the possible permutations of formulas and questions you might receive. More, it actually makes math fun.

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The opportunity for wasting time is great too, unfortunately. Using the wrong tactic can make you feel like you're accomplishing work, but you don't actually know the subject as well as you think you do.

### 3 Stages of Holistic Learning for Technical Subjects

To avoid the perils and get the gains of using holistic learning on subjects like math or finance, I use a simple 3-step system to isolate which techniques I need to use. Fans will recognize this is mostly a reframing of the original 5-step holistic learning sequence, just a little more specific when dealing with technical subjects.

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Those three stages are:

1. Getting the big picture (Acquire->Explore)
2. Getting the calculations right (Debug)
3. Getting outside the box (Apply)

The reason you can waste a lot of time with technical courses is that you overemphasize one of these three steps. Here are a two examples of students who failed to adequately cover all three stages:

Adam spent a great deal of time getting an intuitive feel for his finance class. He understands the models and why they work. He can easily visualize the major concepts and has no trouble explaining it to his friends. Unfortunately, he fails his test because he confuses the formulas and takes too long to sort out the answer to a question.

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Susan knows the test preparations inside out. She knows all the formulas, the best process for calculating answers and the proofs inside out. But when the test comes, conceptual questions are asked and she has no idea what the answer is. Also a later question comes in a format Susan has never seen before, and she can't solve it.

Adam understood the big picture, but couldn't break it down into specifics. Metaphors and high-level concept generation are rarely sophisticated enough to include everything, so when faced with all the details he breaks down. Susan has the opposite problem, with calculating excellence, she can't answer questions that test her broader thinking of the issues.

I'll go over each of these three stages and offer both tactics to improve as well as how to know what deserves your main focus.

## Stage One: Getting the Big Picture

The first stage is understanding the big picture. In the beginning, this means just getting the overall gist of the idea, which can be aided by metaphors and visualizations. Later on, this means understanding all the nuances of a particular formula and idea.

Metaphor and visceralization help early on in the process. For example, understanding derivation it is useful to think of the odometer and speedometer on a car, as they form the first-order derivative of the function. However, this model is only useful on simple examples, not edge cases.

The car example isn't helpful when considering asymptotes. When would a car ever reach infinite speed? The example also

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provides no obvious clues for figuring out trigonometric identities linked to derivatives either.

In this case, the car analogy provides a good starting point. A model which gives you something tangible you can sink your teeth into. But it doesn't offer the nuance of a complete understanding.

As you dive deeper into a subject, however, your models need to reflect those nuances. Instead of just having one analogy, you need to be flexible in shifting between different metaphors or descriptions to attack the same idea. Thinking of variables as jars in computer science is useful until you get to the lower level data, where there are no jars, simply a long row of memory.

Big picture thinking is the most important step to understanding technical subjects. There are two reasons for this:

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1. This step is by far the most difficult. If you can achieve it in a real way, then filling in the details is relatively straightforward.
2. This step provides the most flexibility. If in doubt, I'd overspend time in this stage than in the latter two, since it gives you the opportunity to handle bizarre situations that don't conform to formulas.

The major tactics to use for this step are:

- The 5-Year Old Method
- Metaphors
- Visceralization

I'd start out with the 5-year old method, since that approach will let you take on additional metaphors and visceralization. The

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process of explaining a subject to yourself also gives you direction in creating metaphors. If you get stuck at a part you can really explain, you know you need to look deeper. Randomly creating metaphors is less useful since you may focus on the things you already understand fully.

### Stage Two: Getting the Calculations Right

Unfortunately, just focusing on stage one is not enough. Although in an ideal sense, if you were perfectly able to get the big picture, then all the technical details of solving the problems would be obvious. You should be able to derive the proofs and calculations from scratch, not needing to memorize any pattern.

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The problem is that often you don't have time to understand something that deeply. Instead, you need to master the more focused skill set that you need to use.

Understanding the CAPM model for finance, for example, doesn't mean you'll immediately be able to know all the formulas and how to solve specific problems, off-hand. It certainly helps, but getting a good feel for the theory doesn't immediately translate to practical knowledge.

This second step is, in my opinion, overemphasized by most students. Most students skim on the genuine understanding and stress the technique of calculation. However, there is a risk when using holistic learning to ignore this step altogether and to be completely lost during a test because you can't make the hundreds of inferential steps between theory and a particular formula.

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There are three tactics you can use to work with this stage:

1. Model debugging
2. Deliberate practice
3. Deep process understanding

The first two are fairly obvious, so I'll just refer you to those particular guides. Basically they involve selectively testing yourself on the questions to improve your understanding and competence with the technique.

The third is gaining a holistic understanding of not only the material (from Stage One) but also the process of answering questions. To illustrate the difference, consider calculus again:

**Stage One** – Understanding derivatives, including the edge cases that aren't explained by easy metaphors and mental models

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**Stage Two** – Deeply understanding the specific methods to solve problems.

So while the first stage promotes a general understanding of the topic, the second stage promotes a highly specialized understanding of the methods. If you had done a perfect job with the first stage, this second stage would be unnecessary, but since gaining a perfect understanding can be time consuming, it's better to invest your time filling in gaps where you need it most—on the questions you're most likely to face.

Using our derivatives example, time in the first stage would mean gaining a general understanding of all the parts and how they fit together. This second stage would focus on deeply understanding a particular method—say the chain rule—understanding both why it works (Stage One) but also using holistic methods to remember exactly how and when to use it (Stage Two).

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I could come up with a metaphor both for the chain rule itself, but also for the steps in the process of applying it. This second type of applied learning can make it easier to remember specific methods for solving problems.

### Stage Three: Getting Outside the Box

The problem with the first two cases is that they tend to compartmentalize knowledge. That is, you do extremely well applying the formula when it is given in a sterile context, but rarely use it outside of class.

Sometimes you won't use knowledge outside of class because it isn't particularly useful to you. In other cases, there is a practical value, but because you aren't used to using it, it doesn't present itself as an obvious tool.

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I had a recent experience noticing this glitch. I have taken finance classes, and can do somewhat complex financial calculations. I'm far from a financial expert, but figuring out stock prices based on different pricing models or finding the fair values of securities is an academic task I've performed. Yet when I was trying to figure out the lifetime value of a particular business opportunity, I had a bit of a mental hiccup. The calculations were incredibly simple, but because the context was so different it took me a bit longer to figure out how to apply them.

There is no certain cure for this problem. However, key tactics which help with this approach are:

1. Project-based learning
2. Apply-first method
3. Total immersion method

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If the practical value of knowledge is far more important than passing tests, then using these tools is essential. I feel that when translating to an outside context, if you fail to use these tools, can be the same as a couple letter grade drop in effectiveness. Applying the formula to your real life seems to make the A+ grade you got barely hit a C.

### How to Know Which Stage to Focus On

As closing advice, there are a few rules of thumb you should use to know which stage(s) need work:

You might need to focus on *Stage One* if...

- You don't understand key concepts
- You can't see why a concept *\*must\** be a certain way
- If asked to explain the concept, you can't do so elegantly

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You might need to focus on *Stage Two* if...

- You can't quickly solve problems
- You often make mistakes or forget about important details
- You take too long sorting out the best method to approach a common question

You might need to focus on *Stage Three* if...

- You never use the subject outside of class
- You can't see what the subject would be useful for in your life
- Good luck with this tactic, and I'll see you on the other side!