IONA

MEMORANDUM

0001 - ON CURRICULA

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The success or failure of any educational program is significantly dependent on the quality of the curriculum. Many people have some notion of “what a kid ought to learn”, but most of these ideas are relatively superstitious in nature. One thought is “I learned it so it’s important”, another is “many successful people learned it so it’s important”, and these are useful but most high-stakes decision making in finance and industry follows a much more rigorous approach.

To estimate the effectiveness of current era educational protocols, we might look to the Amish. The Amish have maintained largely the same simplistic educational strategy over the past 300 years - and yet still have surprisingly good outcomes to show for it. The fact that classical western education does not reliably produce better outcomes than that of the Amish is strong evidence that current curricular design is in fact ineffective and needs to be re-thought.

If we are to take a formal approach, we may consider curriculum to be a form of investment, thus allowing us to use Decision Theory to model the value of skills which we may aim to build. In a Venture Capital firm, the goal is to achieve success in each of the startups they invest in, both individually and as a group.

In the case of an educational institution, we invest in many skills in each individual, as we also invest in many individuals. We hope that these skills will work individually and together to achieve success for each person, and we likewise hope that the individuals we graduate will be successful both individually and as a group. Other than having these dual nested levels of individual and group-wise success, the other difference between a school and a VC is that the school is much less risk tolerant. If a VC invests in 20 companies and 19 go bankrupt but one becomes a unicorn, that’s a success. A school cannot morally justify the human cost of a high failure rate.

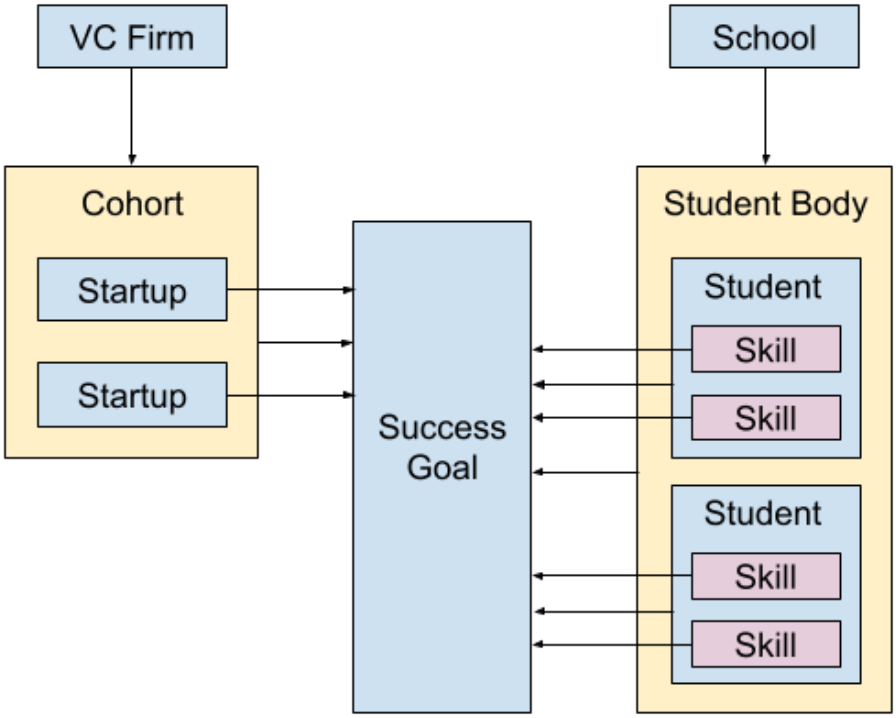


Figure 1: *A Venture Capital firm wants to make each startup successful, but also wants to create a successful cohort. A school wants to teach skills which each individually have a chance of creating success, but also which work together to create a successful person. But at another level, we also want to create people who are successful both individually and as a group.*

Defining Success

Before we can talk about how success is achieved, we need to define it. Investors are generally happy with rising company valuations, but personal success is somewhat more nuanced than this. You might say that “success” is that which nobody ever wants less of. A big portion of this is obviously financial, but it also includes “the things money can’t buy” such as occupational self-determination, family connections, and inner peace.

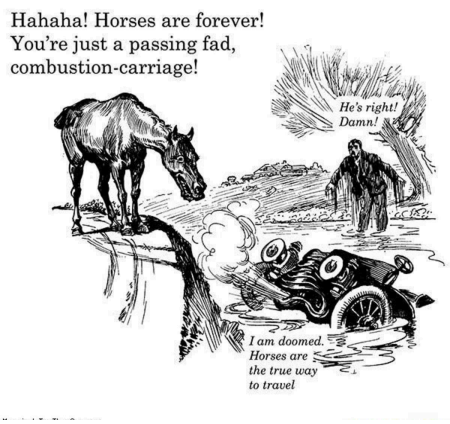
I won’t pretend to know what is an actual good metric for success, but we might postulate that high income, good health, and a happy family comes close enough that it can be used for modeling. Better measurements may be substituted in the future.

Predicting The Future

In elementary school, a teacher once told me I wouldn't always have a calculator in my pocket. In my case this is actually true because I eschew the use of a portable telephone, but it's illustrative of just how fragile future prediction can be.

When attempting to see the future, a commonly used utility is The Lindy Effect; to wit, things which have been around for longer are more likely to persist for longer. This empirical heuristic works because things which are old have stood the test of time and things which are new have not. Radio for example blossomed in the 20th century but is now largely relegated to the margins. But older things such as silverware or clothing have much stronger staying power.

Unfortunately, The Lindy Effect is not perfectly reliable, and its limitations have a major impact on the evolution of careers. A perfect example is the horse, which was the mainstay of transportation for thousands of years until it was abruptly replaced. A comic from the time shows a horse mocking a car that is stuck in the mud. This was a very rational opinion at the time, but now we can see it was completely wrong.



Equestrianism is still taught today, but mostly as a leisure and sporting activity. It would take an absolutely cataclysmic worldwide event to make the horse become once again the most efficient mode of transport.

This is not the first time a technological curve-ball has upset the way things work. The printing press eliminated for good the thousand year old role of Scribe, as written language eliminated the need for memory and retelling of oral traditions.

Even when there is not a shift as significant as the rise of the automobile, fields of employment considered irreplaceable often transition to niche activities covered by a small sector of the population using massive technological leverage. Case in point is farming, in 1920 the top two fields of employment were farmer and farm laborer. Today only about 1.2% of the population are farmers, but modern farming technology allows them to grow many times more food than was grown back then.

Future prediction in the context of career paths is such a troublesome endeavor that we must turn to more powerful tools such as those used in risk modelling.

Prediction As Risk

The field of risk modelling provides a rich set of tools for approaching the most frustrating of problems. One tool which I think is particularly applicable here is the Decision Tree. Using a decision tree we collect possible future scenarios and assign probabilities to them, then we can

envision different decisions (in this case, skills we choose to teach) and estimate their utility value in different scenarios.

If we imagine a total collapse of the food supply infrastructure as 1 in 1000 (1/10th of 1%), then under that scenario we might imagine that having a vegetable garden has a utility value of 100/100. But if there is no such collapse then the garden only offers some positive outdoor recreation and healthy eating which we value at 3/100, so our total value of learning to garden would be 3.1/100.

The beauty of a decision tree is that it gives us permission to brainstorm, considering even highly unlikely scenarios, because we're just going to assign them low likelihoods.

But this strategy is limited in that it doesn't differentiate between low-risk low-reward and high-risk high-reward. Both are considered to have equal utility function. When picking out a number of investments (or say, a number of skills to teach), you want a mixture of some low-risk low-reward with high risk "moon shots".

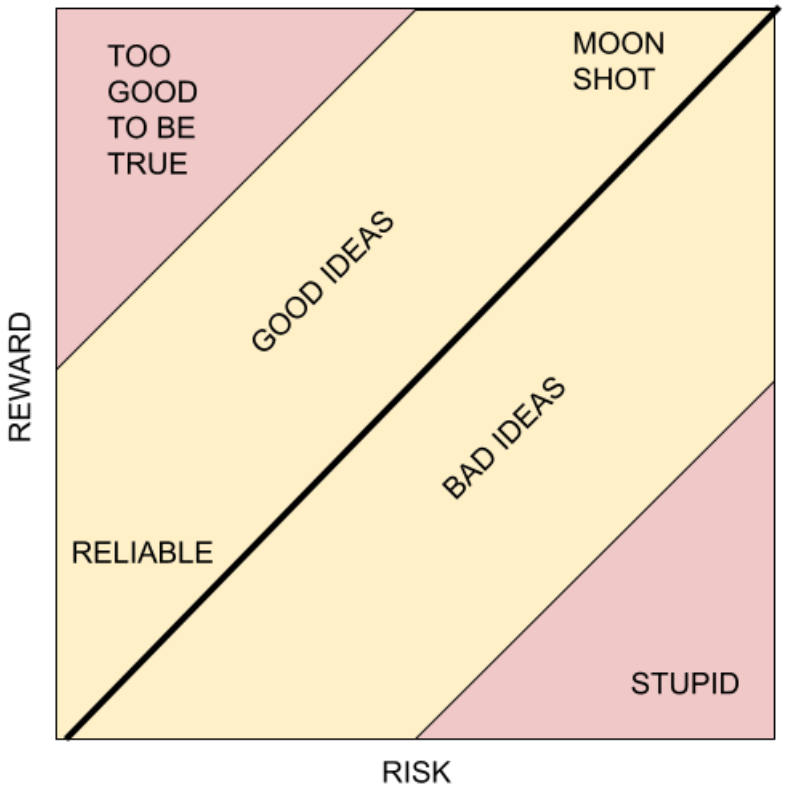


Figure 2: Ideas can be placed on a graph based on the risk (chance they won't work) vs. reward (utility value if they do).

If every skill took the same amount of time to learn and had *no synergies* between them, an ideal education would contain a number of elements up near the “moon shot” category plus one or two very reliable low-risk-low-reward skills.

Synergistic Skills

Unfortunately we cannot just model skills as independent investments because they often have a lot of synergy, and then some skills are fundamental to the development of almost everything else. An example of synergy is if you were to learn metal fabrication and advanced robotics, a lot of what you would be learning would be the same stuff. But something like reading is fundamental because if you don’t learn to read then you’re not able to learn by independent research which makes almost everything impossible.

In order to understand what should be taught, there should be an enumeration of career paths, and for each career, a set of necessary capabilities should be identified. Then each of those capabilities becomes a class, and for each of those, a set of prerequisite capabilities is identified, and so on. This is already done in higher education, for example in order to enroll in Chemistry 201, you need to have completed Calculus 101.

Once these relationships have been developed, forming trees from them is something that can be done mechanically with software. And by merging these trees, we can see the most important topics to prioritize in a curriculum, and make decisions about which sub-set of career paths we are going to focus on.

Student Body Synergies

The last challenge, the one which will determine what career paths make the most sense, is ecosystem modelling for the student body as a whole. This is an easily overlooked area, but it’s because of this that Amish schools beat everyone else with a stick. We cannot only evaluate a career path in isolation, we must also evaluate it as it supports the student body as a whole.

While an airline pilot may do very well for himself, he doesn’t do much to pull up the community as a whole. An entrepreneur is much better for the community because he will create local jobs that will help the other graduates. Individual and group success are two values that need to be quantified in some way for each given career path in the context of uncertain futures.

Conclusion

In order to have a defensible curriculum, we must start with our definition of individual success. Then we need to use a Decision Tree to create a probability field of possible futures. With the Decision Tree, we can then evaluate career paths with respect to their likelihood of success, and their value (in success) to the individual *and* their value to the group. The last point is

ecosystem modelling so the value of any given career depends on the value of all the others. This is the hardest part, but once we have a short list of priority career paths, we can then begin building the tree of capabilities required for each. This is the point where we may discover we lack the resources to teach all of the different types of skills that are needed for all of our priority career paths. We may need to go back and forth between ecosystem modeling and tech tree development in order to find something that is achievable.

The deliverables to support a curriculum should be as follows:

1. A metric for defining individual success
2. A Decision Tree with estimated probability of future scenarios
3. A list of priority career paths where each has:
    a. Baseline probability of success (likelihood that a student will enter in that career)
    b. Analysis of probability in the context of Decision Tree scenarios
    c. Individual value (quantified in terms of our personal success definition)
    d. A statement regarding ecosystem synergy
4. Ecosystem description
5. Analysis of the ecosystem in the context of Decision Tree scenarios
6. Per-career-path tech tree
7. Merged tech trees showing possible career paths which remain open each stage as a student moves up the tree
8. Argumentation regarding risk/reward balance of open career paths (how does it combine moon shots with reliable fallbacks?)
9. Final curriculum

While this is obviously pretty comprehensive, there still remain some gaps in the chain of reasoning. This is by necessity, for example there's just no way to analyze all possible ecosystem models in the context of all possible future scenarios. Attempting such would create a combinatorial explosion that would require software to resolve, and as much as it might seem the contrary, it is *not* the goal of this exercise to over-formalize.

Understanding success and having a predictive vision of the future is critical, and knowing what career paths make sense in the expected future is likewise indispensable. Without ecosystem modelling it is only possible to create individually successful graduates, which may be as good as a decent private school, but remains roundly beaten by Amish schooling practices. There is too much information that must be gathered and analyzed to rely on one's brain alone - it cannot be realistically done without multiple stages of paper deliverables. But all of this taken together is meant to inform the decision process and it will be expert intuition which finally bridges the gaps.