Theory of Change & Research Process

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Theory of Change

There are many aspects of education systems that influence the quality of learning in a particular school or classroom: socio-economic status, school culture, professional development, teacher quality, pressure from standardized tests, etc. For every factor, there are many related reform efforts aimed at improving teaching and student outcomes, and these vary in approach and effectiveness. Here we ask a different question: Knowing what we know about how children learn and what is necessary for individuals and societies to succeed and thrive, **what** should students be learning?

Our hope is to create a framework that can serve as the foundation for deep discussions about our educational design goals and how well we are achieving them. Assessment drives change in education, and we believe that it is crucial to align curriculum and assessment to our values, so that educators can teach in an environment that supports and rewards deep learning across the framework of what needs to be learned.¹

By creating a framework of educational goals, we can influence the discussion about standards for education, and how standards will pave the way for crafting the deep redesign of assessments to make them more holistic and relevant. When assessments reflect updated views on what is important to learn, it will be necessary to redesign curriculum to align with the new assessment approaches, and concurrently, professional development to prepare educators to help students learn the updated curricula, as shown in Figure 1.

Progress will be staggered. When renovating a house, it is important to drastically change only one section at a time, while living in the other sections. In trying to change a large entity like the education system, we must understand that it will not happen all at once. Both the **what** (standards and assessment), and the **how** (curriculum and professional development) need to change over time.

The Center for Curriculum Redesign (CCR) began its work with a focus on goals and standards, and has slowly expanded into all of the interrelated processes. There are now efforts at identifying goals, redesigning standards, designing assessments, crafting curricula, and hosting professional development courses. Of course, we can only do this for a few select disciplines and/or competencies to create exemplars. It will then be up to individual countries and jurisdictions to build out further curriculum and professional development, in ways that are aligned and harmonious with the updated education goals, standards, and assessments, and are best suited to the specific style, needs, and values of each education system.

In addition to the four areas of standards, assessments, curricula and professional development, there is often, in many jurisdictions, a silent influence that has gone mostly unchallenged: college entrance requirements. Such requirements, with their entrance tests, have been constructed to ascertain the student’s ability to succeed in university courses, mostly from a traditional knowledge perspective. They very rarely, if ever, reflect skills, character, and the meta-learning abilities of the student, and are not a predictor for life success outside academia. They often bias the requirements of school systems, in deciding for instance how much algebra should be required irrespective of how useful it may be, and not realizing that it may simply be functioning as a sorting mechanism, by approximating resilience, for example.

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¹ Educators who have reviewed this framework sometimes ask, “Why aren’t you including in your efforts a particular focus on students who are struggling in various ways—socio-economic status, equity, and so on?” We believe these are very important issues, and that there will be a wide variety of ways to adapt and modify learning practices for each learner no matter where they are on the spectra of individual learner needs. CCR is stimulating change at the systemic level, for **all** students, by working with influential stakeholders (such as the OECD) in creating a framework that is robust, comprehensive and adaptable for all.
As this realization starts to sink in, colleges such as Bard and jurisdictions such as British Columbia are challenging their higher education environments to deeply rethink their entrance requirements. More research, analysis, concentration, and innovative problem-solving are needed to understand how to address the need of higher education to fairly sort applicants, yet assess the full individual, and most critically, not hold back progress in transforming education standards and assessment systems.

Of course, there are feedback loops from each level to each of the other levels in this model. Education is a large and complicated system, which is why we need to take a step back, look at the big picture, and be intentional with how we approach this historic education challenge.

The CCR Process

As an independent, non-partisan, international organization, CCR uses an evidence- and research-informed process for developing and refining its frameworks. This process draws from three distinct collaborative efforts: synthesis, analysis, and organization.

SYNTHESIZE:
- prior & existing frameworks
- input from employers
- research from the learning sciences
- future studies and global trends

ANALYZE:
- surveys from teachers
- feedback from global conferences
- social media
- literature reviews + expert panels

ORGANIZE:
- comprehensive: no major elements missing
- compact: actionable and deployable
- uncorrelated: no duplication or confusion
- appropriate layer of abstraction: sensical
- globally relevant: for broad acceptability

Figure 2: The three parts of the CCR process

Synthesize

The CCR recognizes that a lot of work has already been done already in identifying promising areas of education reform. In order to not reinvent the wheel, the CCR uses meta-syntheses on prior and existing frameworks developed by jurisdictions and national bodies (such as ministries of education), professional bodies (such as the National Council of Teachers of Mathematics) and organizations (such as P21.org). It also draws from analyses of employers’ needs (such as an IBM study of 15,000 CEOs from 60 countries and 33 industries). The CCR also ensures that its concepts are current by constantly monitoring and synthesizing research from the learning sciences and by aligning itself with analyses of global trends and future studies. To learn more about our syntheses, see Appendix 1.

Analyze

The CCR believes in the importance of collaboration with relevant parties in the creation of a framework that will support them in their goals. To do so, we have gathered feedback from over 600 teachers from around the
world, and held international conferences and colloquia on issues discussed in the framework (such as mathematics, character, metacognition, employability etc.). The CCR also will begin to gather information via social media regarding what students and parents want from their education. Finally, the CCR conducts specific literature reviews and draws from experts from a global network of thought leaders and partnering organizations (such as the OECD). To learn more about our analyses, see Appendix 2.

Organize

As the CCR draws from so many sources, it is crucial that the final product be *accurate* and *actionable*. The CCR framework aims to accomplish this using the following five design goals:

1. **Comprehensive**
   
   This attribute is the most self-explanatory. It is not enough to create a framework for a subset of the educational goals one hopes to achieve (for example, only skills). Education suffers from an overabundance of programs attempting to fix a single aspect of education. No one approach is a silver bullet, and one needs to think carefully and holistically about education as a system. Furthermore, by focusing on just one aspect at a time, discussions become polarized and force a choice between aspects of the current education system. It is crucial to not leave out any important ideas, so that others who have been thinking of similar concepts in different formulations are able to see the ways in which their thinking can be mapped onto our framework. For example, resilience (a character quality), includes the concepts of grit, perseverance, and so on. By creating a framework that is comprehensive, the CCR is hoping to organize all of the high-level thinking about education design, so everyone can consider how the different elements interact and fit together.

2. **Compact**

   As described above, it is a difficult task to synthesize research in a way that makes the conclusions actionable, yet keeps them accurate. Frameworks that attempt to include all of the nuances of the research literature end up being too difficult to deploy, realistically. Miller’s law from psychology states that people can remember only seven (plus or minus two) items in their working memories, but they can chunk items into groups, thus remembering more items using a hierarchical structure, with the maximum remaining seven plus or minus two. Our framework therefore has *four* categories, each containing fewer than seven components. This ensures that the framework is concise enough to be memorable and thus actionable.

3. **Uncorrelated**

   In reality, many of the goals of education (creativity, optimism, courage, etc.) are correlated to various degrees. That is, someone who is optimistic may also be more likely to have zest, compared to someone who is not optimistic. Research into these concepts often tries to isolate the effects of each factor to understand its importance. To synthesize these different constructs, most correlated items are grouped together, and least correlated items (or uncorrelated, or anti-correlated) are kept separate. Questions guiding this process include: Is it possible to have one without the other? How often does that happen? Has research shown a relationship? That way, each concept is important on its own, and its importance is not mostly captured in another concept, making it more confusing to think of each one independently.

   This clears up confusion that results from different constructs having different origins and overlapping definitions. For example, by separating meta-learning into its own dimension, decision-making is removed from the realm of critical thinking. Now it suggests that one uses all of her knowledge, skills (including critical thinking), and character qualities when making decisions. Linguistic and ontological perfection is illusory, because the concepts all interact to
various degrees. The ultimate goal, however, is for the concepts to be a useful grouping that reflects how these ideas are used in everyday learning and for educators to keep them as helpful checklists in their educational practices.

4. Appropriate
People naturally think of the world in a variety of ways and at a variety of levels. Tying one’s shoelaces and learning how to learn are both referred to as skills, but at very different layers of abstraction. Clearly, it’s important for our students to be good people, and it’s also important that they know how to add. In this framework, goals and concepts are placed in a sensible way according to their level of abstraction, and their origin. So, addition and ethics belong in different dimensions and in different levels of the framework. Low-level mechanical skills (e.g., multiplication) are in subcategories according to their relevant academic knowledge concepts, while ethics is in a category at a higher level, under character qualities. In this way, the framework becomes a foundation for clear discussions that respect the complexity of the many related variables relevant to each educational component.

5. Globally Relevant
As the world is increasing in connectivity, it becomes more important to be mindful of cultural differences and the spectrum of deeper human goals and connections. The CCR framework is meant to be broad and deep enough to not be culture-dependent, but rather to provide a common understanding for effective cross-cultural communication. The ideas discussed here are relevant to everyone in the world who will be participating in constructing the future together. All countries, then, can use this framework and customize it according to their own values and needs.

The CCR framework synthesizes existing research with the overarching complementary goals of maximizing both accuracy and clarity. This leverages all the findings from scholarly research and exemplary practice without getting bogged down in hair-splitting, endless academic debates. By establishing a framework that incorporates the foundational work that has been done on these topics, and formulating it in a clear way, the design goals of education become crisper and provide a common ground for engaging in meaningful work toward redesigning education. On the cognitive science side, the questions that need more empirical research become clearer, so that educators may make their educational decisions as informed as possible. To learn more about our organization methods, see Appendix 3.

Evidence
The human endeavor of social science research is based on the goal of building understanding to ultimately make better choices. In education this is captured in the terms “data-driven” and “evidence-based” reform. In the figure below these two terms are plotted based on their frequency of appearance in books from 1955 to 2000; it is clear that beginning with the 1970’s, and in particular in the mid-90’s, this is has become very important.

But what exactly does it mean to take a term like “data” out of the realm of science and apply it to something like education reform? In much of science, the process of knowledge generation has been highly separate from the application of that knowledge to decisions. But as scientific thinking begins to tackle human and societal questions, science has gotten closer and closer to the decisions downstream of it.

This challenges the categories that have been set up to cleanly separate understanding and acting, and the simplification, which held for cleaner divisions, begins to break down, calling into question both processes. Science has been pushed to take into account constraints and questions from society, and society has been pushed to make its decisions based more and more on science. This is both good and bad. It is good to be
mindful of the relationship between the two, and use insights from each to inform the other. But the downside is evident when the goals, limitations, assumptions, and mindsets of one bleed into the discussions of the other. For science, it can cause the erosion of crisply defined ideas as well as tightly controlled and cleverly designed experiments; for society, it can create a fragile understanding of what knowledge is, and how to deal with uncertainty.

This misunderstanding of understanding is critical to untangling the role of evidence in policy. In the postmodern world, with the democratization of research, writing, and dissemination, it has become clear that data can be massaged, facts can be cherry-picked, and statistics can be bent to fit almost any argument. The social sciences are undergoing a replicability crisis, and discussions of Open Science and the Science of Science are growing. At the same time, the authority of science in the views of non-scientists has increased; it has become common to refer to science as a monolithic entity, which is able to “prove” or “disprove” certain “facts”.

This creates a fragile system. The public holds science in reasonably high regard, but expects its findings to be rock-solid knowledge. This means that in order to completely discount a statement purportedly backed by “science”, all one needs to do is find a counterexample, or show a flaw in the reasoning, and the entire trust that has been naively placed on this fact collapses. At the same time, if one has an attachment to a particular claim, one is able to hold on to it and even more deeply entrench that belief in the face of challenges, because of the intuitive postmodern understanding that evidence can be found to support anything. Selective attention and confirmation bias become powerful tools of those who stand to benefit from a particular side of a discussion. The result is debates in which neither side is able to hear its opponents’ arguments. They are
able to continue to believe their own opinion and easily refute the other side, by showing minuscule examples of incompleteness in their reasoning.

Knowledge is not the accumulation of facts, but the slow, gradual updating of paradigms and eliminating of theories. This is one reason academic writing is so obscure: the focus is not on proving large arguments to be true, but on eliminating and proposing explanations at a scale so small that it can be tested by future experiments. Only over long stretches of time does this work get synthesized into “Knowledge” and presented as fact in Science textbooks. But this is how people are first exposed to science, and the tone – that science knows beyond a doubt that this is how the world works – remains into adulthood, unless one goes on to become a researcher and learns the nuances firsthand.

It is difficult to internalize the true nuances of the scientific process, that at any given point on any given topic, there is a body of research that has been synthesized and is established knowledge, another body of research that is in the realm of reasonable hypotheses, and finally there are claims that are simply unwarranted assertions. From the outside, all of these claims may sound the same, and this lack of nuance can be exploited; those who stand to benefit can paint established knowledge as reasonable hypotheses that warrant a debate and have a legitimate “other side,” or frame reasonable hypotheses as unwarranted assertions by emphasizing the points against them.

The result is that when there is a new idea that challenges the status quo, those that support (stand to gain from) the incumbent position are able to easily “disprove” the challenging idea, and push forward the incumbent idea. The burden of proof lies by default with the challenging idea, rather than with the incumbent idea, despite the current paradigm never truly defending itself to the same standards as those it imposes on new ideas, and its lack of effectiveness at achieving the goals of education. The world spends approximately $2 Trillion per year on education, and seems unable to successfully respond to the needs of society (global warming, employability etc.). One unanswered question is, “why should the challengers be the only ones to be forced to justify themselves?”

Conclusion

Successful implementation of modern education goals will hinge on two critical factors that address all these challenges. At the policy level, we will need to strive toward a stable consensus among political factions, and a clearly articulated vision of the kind of education students now need. At the level of disciplinary experts, there needs to be continuous involvement of real-world users of the disciplines, in addition to reform-minded academics. Parents and teachers will need to be included and empowered in the paradigm shift. A nuanced view of knowledge and science will need to be the foundation for a more accurate discussion of evidence.

We will need to carefully re-examine the relevance of what we teach, curate the traditional disciplines, add relevant modern disciplines and interconnections, and place emphasis on more holistic learning — moving beyond knowledge and into competencies: skills, character, and meta-learning. We will need to leverage best practices from education systems around the world (and from industry where applicable). Finally, we will need the courage to innovate, letting go of the comfort of an existing system and working under conditions of uncertainty toward a better one.

Is CCR’s framework radical or incremental? We prefer to call it “incrementally ambitious”: if it were too radical, it would stand no chance of being adopted, given how complicated it is to modify the course of the formal education system. But if it is too incremental, it will continue missing the mark on what is relevant and needed for this century. The analogy is that of a butterfly compared to its caterpillar: they both share the same DNA, but clearly the butterfly has bitted from a substantial transformation—it has become unrecognizable as a caterpillar, yet reflects the foundational tenets.
Appendix 1: Synthesize

It is important that in our work we do not “reinvent the wheel” but rather, we identify consensus and a comprehensive representative summary. For that reason, the most important and ongoing work we do synthesis.

1. Subcompetencies

One of our main challenges has been to synthesize research, frameworks, and standards around competencies from around the world, to figure out how to break 12 competencies down into the next level of detail in a way that reflects the consensus and latest research on each. We used a qualitative research approach of coding over 100 unique frameworks to pull out common themes and keep track of relevant data, such as age and source. Subcompetencies emerged as codes from the research, and organized the findings into a coherent whole.

This also allowed us to look at the overlap between competencies, as it showed how much of what was coded for one subcompetency was also coded for another subcompetency under a separate competency. The table below shows the amount of overlap for each of the 12 competencies with each other competency. Each row adds up to 100%.

We were able to apply the same methodology to see the overlap among the subcompetencies within a competency, as shown below. This allowed us to optimize for orthogonality in our qualitative coding.
2. Employability Requirements

Another synthesis project CCR undertook was organizing all of the data in the O*Net database of necessary career abilities according to the 12 competencies. To do that, we took the abilities listed in the database and coded each to the construct in the four-dimensional framework that most applied. From there, we created a measure, the Importance Weighted Demand to capture both the importance and the number of people needed for different jobs.²

² For any occupation to which an element is relevant, we take the size of that occupation (as measured by the number of people it employs) and multiply it by a normalized measure of how important that occupation finds that element (as determined by surveys of people within that occupation). We do this for all occupations, then sum the results.
Appendix 2: Analyze

3. Teacher Studies

The largest study CCR undertook independently was a two-part study that asked expert teachers how they would teach each competency through each of their disciplines. The disciplines we covered were Math, Science, English, Social Studies, Fine Arts, Performing Arts, Physical Education, and Computer Science.

In both the first and second round, we collected teacher answers to this question one subcompetency at a time, to make sure they had considered each competency from all relevant angles. We then coded their answers using an internal rubric, and compared the quantity and quality of their answers with each other and with their subjective judgments of how well suited each competency is to their disciplines.

One of our main findings was that teachers really enjoyed this experience, and found it rewarding to stop and think about these questions. Some quotes include:

“The reflection facilitated was hugely important. I don’t, as a teacher, spend a lot of time really reflecting to this level.”

“I got more out of this study than I got out of doing my masters. And, I paid for my master’s.”

“My perspective was changed on my ability to incorporate various competencies into my content area. There was a wonderful discussion amongst all of the teachers on every competency - it was valuable to see where my own competencies fell short and emerged in my teaching.”

“...learning from such great teachers and professionals from across the country. I loved reviewing their ideas and reading about the way they were implementing and teaching the competencies.”

The tables below show the results of the quantity and quality analyses of teacher answers. It is set up so that 1 is average, above average is coded green, and below average is coded orange.

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It was also interesting to see teachers’ subjective ratings of difficulty for each discipline. The graphs below summarize these findings.
For each discipline, the top four and bottom four competencies were highlighted and compared to the teachers’ perceptions. A couple of examples of the comparisons are offered below.

In the first one, we show the discrepancy in the Computer Science group: the competency they generated the greatest number of examples for, only one person placed in the top four. This shows a blindspot across Computer Science teachers - that communication may be a surprisingly good fit!

The second example shown here shows the reverse trend; Social Studies teachers felt pretty confident teaching Courage and Creativity, but they were not able to generate a large number of ideas for those two competencies.

It is important to note that these are two examples, and each discipline had their own strengths and weaknesses, and their own blindspots.
**Instructional Strategies**

The final output of the teacher studies is a list of nearly 50 strategies that were common themes across teacher answers. After coding answers, the researchers again created emergent codes that summarized the patterns. Below are two graphs that shows the strategies in order of decreasing prevalence — the first shows them grouped by discipline, and the second shows them grouped by competency.
Jurisdictional Progress

In a study that was a collaboration with Brookings institute, CCR catalogued the depth to which the 12 competencies were integrated into the missions and curricula of countries around the world. We examined five layers of possible relationships to the competencies, summarized below.

This data was then organized and converted into an interactive data visualization tool on the Brookings website, as shown below. The report summarizing the findings also includes a few other graphs summarizing findings. The main finding was that no jurisdictions included competencies to the level of pedagogy or assessment.

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https://www.brookings.edu/research/competencies-for-the-21st-century-jurisdictional-progress/
Appendix 3: Organize (our work)

1. Truth Table

In determining the orthogonality of the subcompetencies, CCR also employed a logical analysis, which did not rely on data but rather relied on reasoning. In this case, for each competency pair we asked “is it possible to do one without the other?”. It is important to note that these relationships were not symmetrical, so for example, it is perfectly reasonable to do Communication without Collaboration, but not the reverse.

<table>
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<th>Competencies</th>
<th>Skills</th>
<th></th>
<th>Character</th>
<th></th>
<th>Meta-Learning</th>
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2. Elements

To refine the definitions of the 60 subcompetencies identified by the Synthesis work described in Appendix 1, the CCR research team broke them down into their component pieces, and identified nearly 200 “sub”subcompetencies. These were then re-combined into 20 “Elements”, which represent themes across the components making up all the subcompetencies. An example is expanded below.
After the Elements were identified, we engaged in a process of clarifying the intersection of each element and each subcompetency, where relevant. This helped to pinpoint the different lenses that needed to be considered for each competency. A table summarizing the elements’ and intersections’ relationships to Creativity is presented below as an example.

These intersections were used to stimulate the thinking of the teachers in the second round of our teacher study, and to organize their thinking into neat, weekly categories. Each user had a login and each week a few more elements would be revealed. For each intersection, teachers could express whether they liked the characterization of the intersection or they could suggest a change, and were then prompted to complete an idea generation process for coming up with suitable classroom practices.