Theory of Change
&
Research Process

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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**

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.

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 befitted 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.
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.

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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3 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>
<thead>
<tr>
<th>Competencies</th>
<th>Skills</th>
<th>Character</th>
<th>Meta-Learning</th>
</tr>
</thead>
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<tr>
<td></td>
<td>Creativity</td>
<td>Critical thinking</td>
<td>Communication</td>
</tr>
<tr>
<td>Creativity</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Critical Thinking</td>
<td>Yes</td>
<td>n/a</td>
<td>Yes</td>
</tr>
<tr>
<td>Communication</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Collaboration</td>
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<td>n/a</td>
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<td>Mindfulness</td>
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<td>Curiosity</td>
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<td>Courage</td>
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<td>Yes</td>
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<tr>
<td>Resilience</td>
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<tr>
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<tr>
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<td>Yes</td>
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<tr>
<td>Growth Mindset</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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.