The Grand Challenge College: A Vision for Undergraduate Education

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What if the best learning resources were free and widely accessible?

Introduction

"Sustainability" is the central topic of a great many, wide-ranging discussions these days. One subset of those discussions is organized around education and questions of the changes to current practices that would enhance the quality of sustainability education. These conversations range from efforts to articulate new sets of learning outcomes to issues surrounding the administration of interdisciplinary curricular activity to issues surrounding the evaluation of quality and awarding of credentials.

Debates about the meaning of "sustainability" will continue, but if we assume that the outcomes of those discussions are unlikely to change the sense that becoming more sustainable involves doing things differently than we are doing them now, then we can move ahead and think about changes we can make now that are independent of the details of the semantic debates.

The Meaning of Sustainability

While there are still raging discussions regarding the "meaning of 'sustainability'," I argue that underlying all of the semantics, differences and wasted breath there are some core concepts that we accept as "good". Furthermore I think there is fairly wide acceptance that "sustainability" is different from what we are doing now and that its importance reflects a change in the relationship between humanoid Earthlings and our home planet.

With these considerations in mind, the following become interesting questions:

What are the implications / possibilities of the rapidly expanding availability and decreasing cost of knowledge resources?

For the purposes of this essay, the element of most interest is that proliferating knowledge resources along with pressures to innovate regarding course delivery is rapidly creating an environment where curricular materials can be assembled almost on the fly and at very low expense. This makes it easy to imagine courses where readings and other pedagogical elements are highly tailored to the specific learning outcomes of the course and the specific characteristics of the students in the current iteration.

How might social networking and other interconnectivity innovations affect how we organize learning?

Just as the digitization of knowledge resources might enhance our ability to assemble tailored collections of learning materials, social networking will make it possible for us to assemble customized groups of learners and experts around specific topics. These assemblies might be highly dynamic - coming together to achieve specific learning outcomes related to specific elements of a challenge and then dispersing again. And this assembly and dispersion need not be physical.

What elements of our current pedagogical framework might evolve into more powerful forms?

There is currently an emerging conversation about the evolutionary fitness of the semester-long course. This form has been the basic unit of university teaching for many decades. It is a form that is conducive to certain types of learning and it is horribly familiar. But it is not the only way that individuals and groups of students can gain access to and mastery of codified subjects. Static course catalogs reflect an historical assumption that basic knowledge is static and that pedagogy can be similarly static.

The special topics course and the graduate seminar are more flexible forms of the semester long course. They acknowledge the growth of knowledge and the sometimes ephemeral nature of some ideas.

What will distinguish future graduates from ourselves? and *What of those differences will distinguish the University of Minnesota from its peers?*

Already there is a growing shift from emphasis on facts-based learning to skills-based learning. Future graduates will be called upon to function in workplaces and decision frameworks that are highly dynamic compared to those of which provided the livelihoods for those of us in the baby-boom generation. Where economic sectors and fields of knowledge changed slowly compared to the career-span of college graduates in the mid-20th century, change is now rapid-compared to career-spans. Universities and colleges must acknowledge this and evolve accordingly.

Graduates in the future will be called upon to solve problems; and those problems are likely to vary in type constantly. In times of roughly static knowledge frames, problems can often be classified into known types which succumb to established solution processes. Graduates in the coming decades will face an ever changing landscape of problem types. Interconnected innovations are likely to render specific solution approaches obsolete almost as fast as they are developed.

At the University of Minnesota we can distinguish ourselves from our peers by adapting to these changes in what our graduates and alumni will need as professionals and as citizens. With the Sesquicentennial of the Morrill Act upon us, we can take the opportunity to experiment with new approaches to education, to explore the changing role and character of knowledge in our society, and to begin to invent new institutional structures that will produce graduates and partnerships that are renowned for their ability to grasp and solve challenges and to adapt as those challenges evolve.

Grand Challenge College

The Vision

Imagine an undergraduate experience organized around problem solving and team work. Teams of students, faculty and other partners are working on real-world problems in places both near and far. These students' progress is measured in terms of learning outcomes that include traditional codified knowledge (such as the calculus, principles of micro and macro economics, basics of historiography, etc) as well as leadership, management skills, and problem solving skills. Among the data used as metrics in their evaluation would be the relationship between the team objectives and their accomplishments.

Teams would be dynamic and could have lifetimes of multiple years. Each team would have articulated objectives for both learning outcomes and impact. When those outcomes are met, the team's activities are reviewed and the team either disbands or reconfigures in light of a new set of objectives. The finite lifespan of the teams would be facilitated by the graduation of students.

As students graduate and move on to other endeavors, they will carry with them the knowledge, skills and experiences of strong engagement with complex problems and with the processes and challenges of solving them. They will have learned how to learn, they will have acquired some basic knowledge and, if all goes well, will have contributed to improving the lives of some others here on Earth.

University Operations & the GCC

University operations will provide a number of hands on problems for grand challenge teams to work on. In fact the pedagogical structure of the GCC should reflect our best understanding for moving toward goals that our communities considers to be improvements in quality of life.

Not the least of that pedagogical frame will be the mode of decision making. Goal identification is central to sustainability and how we comport ourselves as communities is a fundamental reflection of what we value.

The Pedagogy

Three ideas are at the core of the pedagogy here:

1. that our understanding of how biophysical and socioeconomic systems work and of how those two large Earth subsystems interact will change rapidly in coming decades;
2. that in addition to "knowledge about," our universities should be providing "experience with" how the world works; and
3. that there is tremendous heterogeneity among human societies regarding what constitutes a "good life" and regarding the priorities for improving from the present.

With these ideas in mind the pedagogical frame of the Grand Challenge College will explicitly embrace change regarding our knowledge and objectives, and it will draw heavily on evolving social media and other technological elements that increasingly connect and mediate inter-human and human / nature relationships.

The Student Experience

The Grand Challenge College (GCC) will attract and admit exceptional young students who are already self-motivated learners. They will be curious and their collective curiosity will span the full gamut of human endeavors and natural wonders. In the limit of the GCC idea, entering students would join pre-existing teams and those teams would provide the setting for their apprenticeships. Graduate and journeyman students would mentor younger students on a daily basis while faculty members would provide wisdom and overarching strategy.

Calculus in the GCC

We know how to teach calculus. And we know that some teachers are much better at it than others. The text I used in the 1980s was first published in 1951 and it helped my daughter learn the subject 60 years later.

While GCC will have faculty who can mentor and assist with calculus, it is highly unlikely that the GCC will employ faculty to *teach* calculus. Students will learn the subject from the best teachers online and will tailor their curricula to their needs and time frames.

In roughly the first half of their time in the GCC, students will focus on building basic knowledge and professional skills. Their learning would be in the context

of support for problem solving, background research, and problem framing as shaped by the societal outcomes that the team as a whole is working toward.

It is likely that in these first years apprentice groups that cross team boundaries will come together to achieve specific learning outcomes in ways that are reminiscent of introductory classes in traditional education. And while learning outcomes in this phase of their education may remain fairly familiar to those of us educated in the late 20th century, ever-changing problem sets and lecture formats will be markedly different.

In addition to conceptual foundations in traditional disciplines, the curriculum in the GCC will include newer fields such as systems thinking / modeling, design thinking, scenario planning and professional training. Professional schools and continuing education programs are currently the leaders in teaching these fields; an important element of the early design of the GCC will include inventing infrastructure to support scholarship and innovation in delivering knowledge and experience that prepares students to use these tools.

Toward the end of their second year, with their apprenticeships drawing to a close, students will consider options for their journeyman period. Those options will include:

- staying with their initial team
- joining another existing team
- starting a new team

Factors influencing this decision will include:

- the needs of the current portfolio of teams in the GCC;
- evolution of the student's interests
- assessments of Grand Challenges that are not addressed by the current team portfolios.

Apprentice / Journeyman Metaphor

If this metaphor were carried to its conclusion, we might associate graduation with achieving the status of Master. I think this would be pushing too far. At best, the roughly 4 years imagined here would put a student in the midst of their journeyman period.

In the first two years students will start to develop expertise in certain areas. Those areas might be discipline based and they might be process based. Some students will be particularly adept at solving problems in the physical and biological sciences; others will gravitate toward application of knowledge and engagement with stakeholders beyond the university. It is likely that all teams will need some aspects, albeit to varying degrees, of most of the major categories of talent that the GCC attracts and nurtures.

The choosing of a journeyman team has pedagogical elements in and of itself; not the least of which is helping students to think about how to market their own skill and to manage their own professional development. This learning element should start when the student first arrives as they start paying attention to other teams and attempting to tune their own learning and skill to what they predict will be the needs of an interesting team at the time of their apprentice-to-journeyman transition.

If successfully designed, the team evolution part of the GCC will produce teams that are transdisciplinary[1], that produce outcomes that are useful beyond the university and that prepare students for a job market that is very different than that of the mid-20th Century. Participation

[1] Time may be short for full-on transdisciplinary development (e.g., Gibbons et al. *New Production of Knowledge)* but we should think of the entire 4 years as available for the gaining of the implicit and tacit knowledge of other disciplines.

in a team that successfully produces a previously articulated outcome and successful mastery of a set of foundational knowledge and learning skills will qualify a student for an analog of the traditional Bachelors degree.

The Role of the Institution

Curriculum

The conceptual design of the GCC calls for institutional elements that are not currently common-place in our universities. For instance, the problem focus and self-organizing elements will require much more dynamic approaches to curriculum than is possible with our current course listings and approval processes. As knowledge access and instructional quanta become more widely available and their cost continues to fall, our capacity to assemble courses to address *ad hoc* collections of learning outcomes will improve.

Taken to the extreme, the GCC will not have a fixed course catalog at all; in that limit, all curricular activities are emergent and come together in response to particular portfolios of needed learning outcomes (e.g. just-in-time curricula). Practically, it is likely that certain sets of desired learning outcomes will be common (e.g. system model articulation) and better and worse solutions to achieving those outcomes will be identified.

The need for some traditional codified knowledge will remain (e.g. the calculus and statistics) and solutions for delivering that knowledge will be well known and cataloged. As noted above, solutions to those needs will not necessarily be provided locally. Solutions to gaining codified learning outcomes are well known and the GCC will take full advantage of those resources.

We have traditionally used courses as proxies for learning outcomes and charted progress toward a credential in terms of successfully following a course based path through an available curriculum; in the GCC that path is delimited by learning outcomes. Courses often have a set of learning outcomes that they are designed to impart and hence each of those outcomes is linked to the others and to the format and duration of the particular course. If instead we use outcomes as our metric and we relax our notions regarding the format of a course, then institutions and students have a great deal more options for finding a route that accumulates the requirements of the credential that they seek.[2]

Grand Challenges

A key institutional element of the GCC will be the infrastructure for assembling and addressing grand challenges. This element has two interconnected parts:

1. Identifying the challenges to address; and
2. Identifying the desired outcomes related to specific challenges:

Faculty and strategic planners will be central to the first; strong community engagement and outreach will be central to the second. The long-term success of the GCC will be a strong function of the ability to recognize and act upon the strong overlaps between the two.

Assembling a portfolio of grand challenges will be a central strategic element of the GCC; the composition of its challenge portfolio will manifest the institution's understanding of the world and will highlight the norms and values of the institution. In identifying challenges to take on, the GCC will weigh the skills of its faculty, the needs and resources of its surrounding

[2] This is a lot like the competency based credentials that are being developed in a number of state institutions.

locale, the strengths of its local and international partner networks and its institutional priorities.

Connections between the GCC and societal elements beyond the institution are of particular importance in the assembly of the challenge portfolio. Where the GCC may be able to more or less articulate important challenges, the priority and detailed character of solutions to those challenges can only be articulated by the people whose lives are affected. In this shift from a focus on knowledge generation to societal outcomes, the GCC can be an interesting experiment in the evolution of academic institutions.

If the GCC model is successful and other institutions create analogous colleges, then it is likely that multiple GCCs will have overlapping grand challenges. GCCs will compete to distinguish themselves based on:

- Nuance related to how the challenge itself is articulated (e.g. locales that are chosen, details of emphasis, etc.);
- How well they articulate desired outcomes;
- Success in achieving those outcomes.

Students will choose a GCC based on its Challenge Portfolio and on the skill with which the University addresses those challenges.

Student Services

Imagine a GCC registration process that revolves around a social networking framework. In this system students will express interest in particular topics and then form groups based on common interests and needs related to that topic. The emergence of these groups will be monitored or overseen by GCC faculty who will serve as advisors in the development of lists of related learning outcomes and possible strategies for achieving them.

In this model, the role of the university or academic institution becomes that of supporting the activities of these students. Faculty research and scholarship becomes tuned to the outcomes that the GCC has prioritized. Students organized around topical interests and pedagogical needs can also provide research support to faculty as part of their learning. In addition to knowledge generation relationships among students and faulty, there will be a strong need for faculty members to serve as mentors and managers as the teams evolve.

While forward-looking education is at the core of the GCC, an important metric in thinking about the success of the GCC will be the career paths of its graduates; thus the GCC will need to have strong support for internship and career placement. The institutional relationships that are necessary for successful functioning of this kind will be dual purpose. First they will provide GCC students with access to conditions and cultures beyond academia that will provide entry in to the world of work that awaits them upon graduation. But perhaps more importantly, these relationships will be the foundational network for recognizing and articulating both challenges and desired outcomes. An office that performs these functions will be both a student services office staffed by professional staff, but also a strategy office that is staffed by faculty and GCC leadership. The office will be successful to the extent that the distinction just drawn is as invisible as possible.

Teams

Two types of teams have been discussed in the paper so far. The first instance was teams organized around specific challenges and the second was teams organized around topics and

learning outcomes. This emphasis on teams is part of the GCC shift from the role of the University as the parental conveyor of knowledge to that of a living substrate upon which 18-24 year olds (or ongoing learners) hone their skills and knowledge to solve real problems.

The expiration of teams is always a challenge. The course-like teams have built in endpoints: have the members achieved the desired learning outcomes? If so, the team disperses; if not, carry on. Teams organized around challenges are harder to evaluate because the outcomes that they are working toward will often be longer-term than the actual work to set us on a proper trajectory. Evaluations of such teams and decisions regarding their vitality will be an important part of the strategic functioning of the GCC.

The New Faculty

Just as the student experience in the GCC will be entirely new, the experience of faculty in the GCC will be dramatically different. In particular, where the traditional faculty role has strong elements of omniscience, in the GCC that authority will be strongly tempered by pedagogical importance of guiding students as they identify the key elements of the problems they have chosen to work on.

In the GCC the responsibilities of the faculty will include:

- Ensuring that students graduate having mastered a rigorous and comprehensive set of learning outcomes;
- Managing the portfolio of grand challenges to ensure that they are well formed and that desired outcomes are well articulated;
- Providing strong mentoring and guidance to individual students and to teams; including team composition and team evolution including sunsetting;
- Working with other GCC faculty to maintain a rigorous knowledge map of current and coming challenges and to produce an overall transdisciplinary (mode 2) framework for the GCC.

In the GCC model, faculty will not teach large introductory courses; they will lead seminars, special topics courses, design studios, field projects, etc. As noted above, topics with well established syllabi and pedagogical frames will be sub-contracted to the best available instructors where ever they may be.

A final element of the faculty's role is in certifying that students have achieved sufficient mastery to be awarded the GCC's credential. In addition to the tallying element of the learning outcomes, students must achieve a certain level of professional preparedness and maturity.

The differences in the role of the faculty in the GCC will also contribute to an evolution in the parameters used to compose a faculty. Following Ernest L. Boyer[3], as a whole, this faculty should have a portfolio of skills that is broader than that of a traditional faculty and that includes experts on engagement and outreach and pedagogical innovation among others.

[3] *Scholarship Revisited: priorities of the professoriate*. 1990. The Carnegie Foundation for the Advancement of Teaching.

From Here to There

The Grand Challenge College will not come into being fully formed. In fact all of its elements may not come together in the same place until many years of experimentation have occurred. That said, here are some thoughts on what some first steps might look like.[4]

A Model for a Pilot

A starting point for the challenge organization might be a final year program that is immersive and comprehensive. Juniors could apply to be part of an ongoing challenge team; they would have to be within some proximity to the requirements for graduation and the learning outcomes elements would be related to capstone projects and advanced requirements for specific degrees.

This sort of pilot could be run with several tens of students, 1 or 2 faculty mentors and some administrative support. With experience, it could easily be scaled to multiple senior year programs.

The next step in the evolution would be to expand the senior program to a 2 year experience. Expansion to multiple years will stretch the metrics and student evaluation framework in important ways.

With a 2 year program in place, the major design elements will be in hand and the challenge shifts to expanding the scale of the program. It is at this point where evolution of the faculty becomes a factor and strain will begin to be felt on the evaluation criteria. It goes without saying that the program will need to be built by tenured faculty members.

The final step in implementing a full GCC will be admitting students directly into the program. Decisions and planning for this step should be firmly rooted in experience with the 2 year program and include the following considerations:

- What are the characteristics of the students who thrive in the program?
- How have the first 2 years at an institution prepared sophomores for entering the program?
- How might the first 2 year's experiences be modified to better prepare students for the challenge program?

Building some Pieces

There are a number of places where we can build infrastructure to support the GCC or challenge programs in the spirit of the GCC. These pieces will be necessary for the full program, but will have value even in its absence.

Internships and Community Engagement / Enhanced support for out-of-classroom learning

This is an area where there are already wide spread efforts to enhance our capacity. These efforts are part of academia's evolution in response to changes beyond its borders.

Self-assembling Learning Groups / Tailored social networking tools

Incoming freshman in 2012 have a very different social infrastructure than those whose freshman year was even a decade ago. They move seamlessly from face-to-face interactions to

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[4] That said, a small innovative institution whose business model is resilient under conditions of innovation might be bold enough to give it a go. Unity College comes to mind (http://www.unity.edu).

University-specific infrastructure would likely be built on top of widely used social media tools. We have a large amount of data that could be used to catalyze the emergence of groups, but privacy issues will likely limit the extent to which those resources can be brought to bear. It is likely that early participation would need to be on an opt-in basis. The core of the task is to identify existing or potential connections. Early applications might be aimed at forming study groups or project teams in large classes.

Dynamic Curricular Elements / New forms of content

With a coda folding back to the opening thought…

Much of the challenge part of the ideas here can be accomplished within the existing university curricular frame, but real innovation will be in reconceptualizing the undergraduate experience.