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A Physicist in Honors

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CONTEXT

I have been asked to provide a retrospective connecting my recent decision to resign as dean of the Honors College at the University of Nevada, Las Vegas (UNLV) with my involvement in NCHC as a proponent for the inclusion of more and better mathematics and science in honors education. My career in honors began in 1985 when I was appointed the first director of UNLV's Honors Program and formally ended this past summer with my return to the Physics Department at UNLV. During the period between the Pittsburgh conference in 1995 and the San Francisco conference in 1996, I had the pleasure and honor of serving as NCHC President. In between those endpoints, 1985 and 2000, I have presented several workshops on the topic of science and mathematics education at honors conferences and had various musings about pedagogy published in honors journals (see References). What follows is a summary of successes and failures intermingled with suggestions on science and mathematics education in honors with an overlay of more general observations gleaned from fifteen years in honors.

BACKGROUND

The honors curriculum at UNLV has strong requirements in both mathematics and science because of the resonance of two influences: one internal to campus and the other external. The obvious internal influence was my background in science and mathematics and my role as the chair of the committee that designed the Honors Program at UNLV. The external influence is less obvious.

In order to build support for honors on campus, I contacted Lothar Tresp at the University of Georgia, who was then the Executive Secretary and Treasurer of NCHC, and requested information about Honors Programs that could serve as models for our incipient

program. One of the schools Lothar suggested was the University of Utah. It had the advantage of being recognized as an outstanding example of honors and was geographically close to UNLV, at least by the wide-open spaces standards of the west.

When I called Dick Cummings, the Director at the University of Utah, he was very helpful and sent a wealth of material that I shared with the committee. Unbeknownst to me or the committee, we happened to have a sample honors curriculum from a school that required all students in honors to do at least one quarter of calculus. Although the majority of faculty on the committee came from disciplines that did not require calculus, the combination of my bias and the curriculum at the University of Utah carried the day. One semester of calculus was included in the committee's recommended honors curriculum for all students earning an honors degree at UNLV without a single dissenting voice.

UNLV has a general education science requirement of two science courses including at least one with a laboratory. It was straightforward to require students in honors to complete two science courses with laboratories. Both the calculus and science requirements will be discussed in more detail below. But before the practical and philosophical bases for these courses are presented, one more accidental but important decision about the honors curriculum at UNLV has to be pointed out.

As implied above, UNLV has a general education requirement. Coincidently, the general education curriculum was going to begin at the same time as the honors curriculum was implemented, the fall of 1985. Consequently the honors curriculum was designed to be a more robust version of the general education requirements. This honors curriculum was the same for all students regardless of major on campus. The uniformity of requirements for all students was, at least overtly, predicated on what turned out to be the false assumption that the published general education requirements were going to apply uniformly from department to department and college to college. As it turned out, various programs on campus had special dispensation from this or that requirement making the general education requirements substantially less robust than they first appeared to be. These dispensations did not apply to the honors version of the requirements, at least partially due to the fact that when the honors

version was approved there was not a widespread understanding of the dispensations that had been granted to various programs, and this has helped to distinguish and clarify the honors core from the regular core.

The honors curriculum at UNLV ended up requiring substantially more honors courses in science and mathematics for non-technical majors than most other institutions offering honors. This was not an explicit decision but came about quite naturally as explained above. It did not take long for me to realize that it is much easier to require courses of all students than it is to muster the faculty and institutional support to offer those courses in a consistent and predictable manner!

VISION

The plan was to design new courses in mathematics and science for honors students majoring in non-technical areas. These courses would be taught under the HON imprimatur. I had colleagues in mathematics and science do the actual planning (I served on the science committee). The design parameters for the mathematics course were a two-semester sequence for students coming out of high school with three or more years of mathematics. The second semester of the sequence would be an introduction to calculus.

The science course was designed to be four-credits each semester and interdisciplinary. The common theme was evolution. How did the universe come into existence? Where did organic molecules come from? How did the earth become habitable? How did life arise? The first semester ended up being a combination of physics/astronomy and chemistry, and the second semester combined biology and geology. There was a laboratory each semester. The original concept had the science courses being sequential with the introductory calculus course as a prerequisite.

PHILOSOPHY

This is really a parenthetical insert. At the time these courses were being put into place there was no philosophical soul searching about the role of these courses in the honors curriculum. Over time, the rationale for the courses has been challenged by students and some faculty. Hence some veneer of plausibility had to be developed to

defend what, to some degree, had become one of the defining characteristics of honors at UNLV. Please keep in mind that, for better or worse, honors began at UNLV with strong components in mathematics and science for non-technical students. It is much easier to defend the status quo than to argue for change.

Calculus was chosen as the central theme for the mathematics sequence because it was viewed as a pivotal development in the growth of science and technology and as one of the great achievements of human thought. The idea of the limit and the role of the derivative and integral played a role in mathematics similar to that of evolution in biology. Hence it was felt that all educated people ought to be familiar with the intuitive simplicity of calculus. Also, when the curriculum was being developed, there was a presumption that the honors science sequence would require the calculus course as a prerequisite.

The science sequence was somewhat easier to defend. First, on the surface it is not qualitatively different from the regular science requirement. Second, there is more recognition that educated citizens living in a world with accelerating technology ought to have some minimal understanding of the current scientific world view. One of the points of emphasis in the science sequence has been the role of experiment and observation in science, presenting science as a method for seeking truth and not as a compilation of Truths.

More generally, one of the themes in honors became communication. Understanding the language and mode of speaking in mathematics and science was seen to have value in and of itself. In fact, one of the explicit themes of the honors science course—which, like many things, got lost in the reality of staffing the sequence—was to help students appreciate the way scientists from different disciplines view the "scientific method" in dissimilar, discipline-centric ways.

Mathematics, and mathematicians, have a standard of proof that is higher and more rigorous than that found in any other discipline. Although students rail against having to learn proofs in mathematics courses, learning how to prove something to the satisfaction of a mathematician is extremely valuable, even as it is often frustrating! The following comes from a list of suggestions distributed to faculty teaching lower division honors courses:

The content of lower-division honors courses runs the gamut from rhetoric to calculus, a spread that makes generalizations about process difficult. With that caveat, I will now generalize. The emphasis in an honors course should be on communication—both written and oral. This may seem bizarre for a calculus course (or a physics course), but aren't examinations a way for students to communicate what they have learned and understood about some topic, for example, a short story, essay, chain rule differentiation, or Newton's three laws. Different disciplines have different modes of communication built on different paradigms.

IMPLEMENTATION

The mathematics sequence has been offered every year since 1985. The original titles for the courses were ***Honors Precalculus*** and ***Honors Introduction to Calculus***. After several years, the titles changed to ***Honors Mathematics I and II***, but the purpose of the sequence remained unchanged. The name change came about primarily due to preconceptions held by mathematicians about precalculus and, to a lesser degree, calculus. The honors precalculus course ended up being a revamped version of the regular precalculus course. This missed the point of the sequence. The name change came about as a strategy to encourage the people teaching the honors mathematics sequence to be more creative with respect to the material covered. The Mathematics Department has been very supportive with respect to staffing this course but less supportive with respect to buying into the concept and accepting ownership of the sequence.

The science sequence, with two faculty teaching each semester, has been offered every year since 1986, the first year that the honors program at UNLV had sophomores. This course uses a disproportionate amount of faculty time because of team teaching and the required laboratory. Over the years, the second semester, a combination of biology and geology has been taught more consistently as an integrated course. There has been a tendency for the first semester to be taught serially, first by a physicist and then by a chemist. Although

staffing this course has been a problem in the past, there now appears to be solid support for the science course at the college level. The material in the science sequence never actually required calculus; hence that prerequisite requirement has quietly disappeared. The science courses have also evolved away from the original idea of two courses that formed a coherent sequence. Now they are offered as two distinct courses that can be taken in any order.

EVALUATION

The major success UNLV has had with respect to these courses is that both the mathematics and science courses have been taught consistently, that is on a regular basis. Also the requirements have survived fifteen years and, with luck, will continue to help define the meaning of an honors education at UNLV. Unfortunately, it has been more difficult to get students to buy into these requirements. Every semester, there are some number of students who wonder why _____ (fill in the blank with the major of your choice) need to take calculus and/or science. Of course the majority of students take the courses and successfully complete them without giving much thought to the efficacy of the requirements. A small number of students actually recognize the value of the courses and embrace the requirements. But they are clearly a minority. This has made the sequence less fun to teach than it ought to be for faculty. Consequently, there is continual and persistent pressure from students to relax these faculty-intensive requirements and little enthusiasm from faculty to defend them. I am curious to see if these courses and requirements survive the change in leadership of the Honors College.

SUMMARY

The Honors College at UNLV now has over 600 students participating. Eighty percent of the graduates come from four colleges: Liberal Arts, Business, Science, and Engineering. The remaining graduates come from the colleges of Hotel, Education, Urban Affairs, Health Sciences, and Fine Arts. There are undoubtedly students who decide against participating in honors because of the science and mathematics requirements, and others who participate but do not complete those requirements. On the other

hand, the sheer number of participants and their distribution among different colleges suggests that the requirements have not been a major deterrent to the growth of honors at UNLV.

A WORD ON STEPPING AWAY FROM HONORS

Although I never doubted that I would return to the Physics Department before the end of my career at UNLV, I could never quite bring a plausible transition scenario into focus. I had difficulty picturing being on campus watching someone else run honors. I had always imagined some singular event initiating the transition back to physics. My epiphany this summer was realizing that there never would be such a singular event! That the only way to allow honors to outgrow my vision was to step away, not step aside. Stepping aside implies less distance between the starting and ending points. Although I am happy to be consulted as a senior statesman of honors whenever the powers that are deem that reasonable, I had and still have no interest in casting a shadow, albeit a small one, on the post-Zane Honors College at UNLV. In fact I have been having so much fun twiddling equations that my career as a university administrator seems like a faint memory of a previous life.

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