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# High to Low Tide: The High School–University Transition

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*In this paper I summarize some key findings from a three-year study of the high school-university transition for students attending a large arts and science faculty, within the context of their first university chemistry course. I then discuss these results within the broader context of research on success in higher education. Final conclusions are drawn from both my own observations and participant discussion from the session at the 2009 Society for Teaching and Learning in Higher Education (STLHE) conference at the University of New Brunswick.*

## Considering

Every year, a large cohort of students arrives at this institution from high school with high grades and higher expectations. Many of these students intend to pursue a life sciences degree, with the ultimate aim of a professional medical career. As a result, some 1,500 to 1,800 students enrol annually in our first-year chemistry courses. This is a relatively smooth transition for some, but extremely traumatic for others who find that high school excellence does not translate into university success. While many instructors grumble about the declining quality of students, or their lack of work ethic and sense of "entitlement," this really does not do justice to the majority of students who devote long hours to their studies. What, then, are we to make of that sizeable group of students who, despite their best efforts, find themselves failing those courses that are so essential to their dreams? And, more importantly, what can we do to identify and assist those who, in the words of one student, come to feel that university is the "place where hopes and dreams come to die"?

## Getting an Education…

The genesis of this paper comes from an educational research project I began in 2006 to look specifically at those students taking first-year chemistry (Stone, 2009). The goal of this mixed-mode study was to answer the questions:

1. What factors contribute to a successful high school–university transition?
2. What can schools and universities do to help students manage this transition?

Over a three-year period, 1,270 out of 5,356 students enrolled in one of three first-year chemistry courses during the Fall semester completed on-line questionnaires. Additionally, some 40 students participated in semi-structured group interviews run by second-year students through our undergraduate research opportunity program. For the second and third years of this study, I was also able to match individual student surveys with final course grades.

In some respects, the survey findings were unsurprising, particularly given current trends in university admissions and the competition for admission to our life science programs (Table 1). The majority of students completed high school in Ontario, obtaining high marks in Grade 12 chemistry with an average around 87%. Students experience substantial "sticker shock" when they see university large class averages for the first time: for the two single-semester courses taught here, the averages over the study period were 67% and 64%, respectively. Of course, many quite rightly expect university to be harder than high school – though individually not expecting to find it *that* much harder! In fact, students report being warned to expect a drop of from 10 to 20 percentage points in grade average from high school. What is disturbing is the number of students who experience a much greater drop in academic achievement (Figure 1). Indeed, fully *one quarter* of students participating in the survey reported their chemistry grade dropping from 30 to 60 percentage points – and that does *not* include those who did not write the final exam. Such a reversal of academic fortunes is clearly devastating for the student, and has significant implications for student engagement, satisfaction, and retention.

Table 1

*Summary of Survey Cohort Characteristics*

| Category | 2006/7 | 2007/8 | 2008/9 | Aggregate |
|---|---|---|---|---|
| Size of survey cohort: | 1830 | 1803 | 1723 | 5356 |
| Response rate: | 17.5% | 29.3% | 24.0% | 23.7% |
| Male: | – | 39.4% | 40.6% | 40.0% |
| Female: | – | 60.6% | 59.4% | 60.0% |
| ESL students: | – | 55.2% | 53.9% | 54.9% |
| Ontario students: | 86.3% | 84.4% | 84.5% | 85.1% |
| Regular curriculum: | 68.1% | 82.3% | 78.8% | 78.0% |
| Semestered program: | – | 58.4% | 65.1% | 61.3% |
| Mean HS grade ± *s* (%): | 87.3 ± 10.6 | 87.1 ± 7.1 | 87.3 ± 7.2 | 87.3 ± 7.4 |
| Mean CHM138[1] grade: | 69.7% | 65.0% | 67.2% | 67.3% |
| Mean CHM139[2] grade: | 63.8% | 63.3% | 64.6% | 63.9% |

[1] *Introduction to Organic Chemistry*
[2] *General & Physical Chemistry*

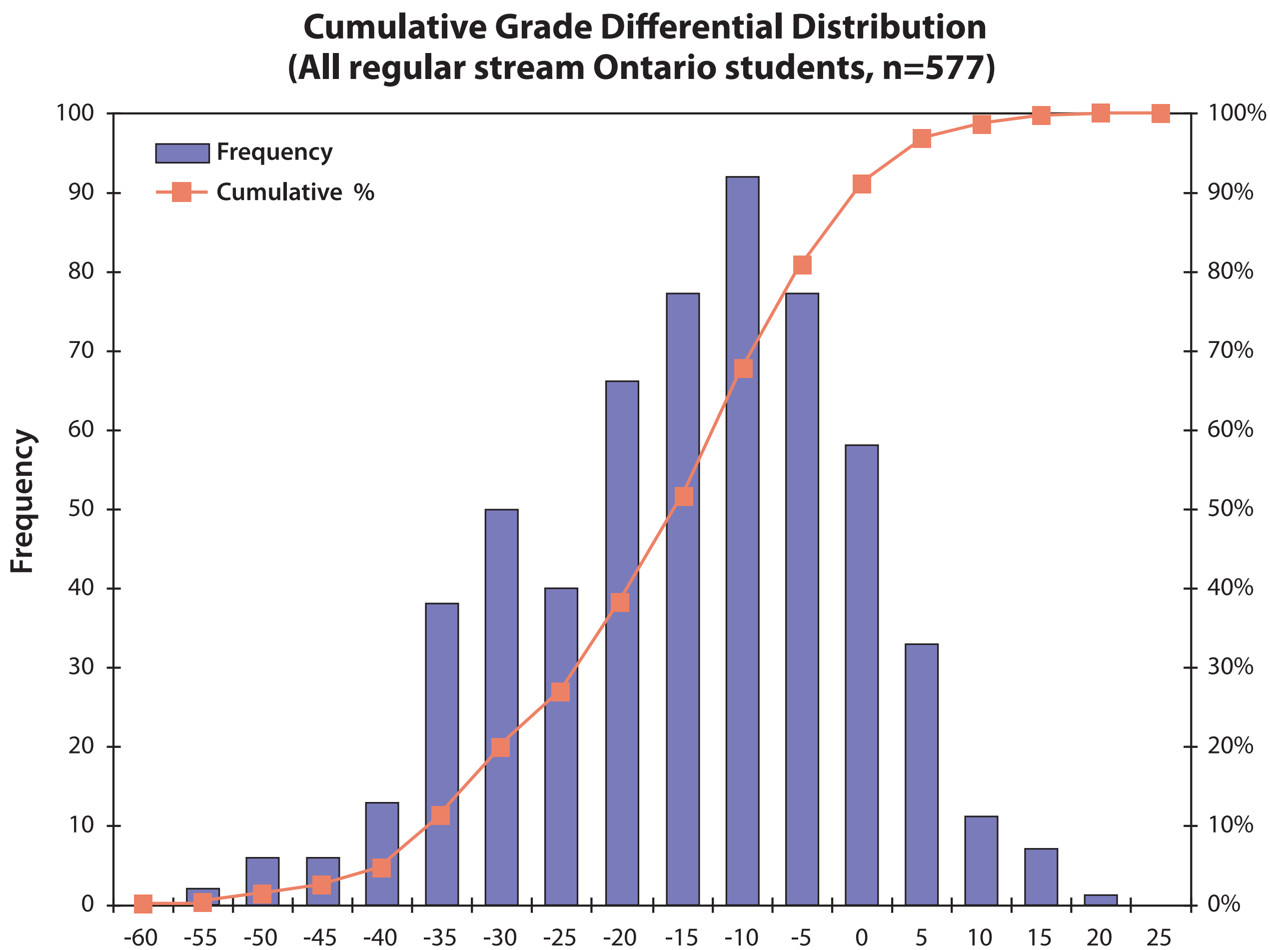


FIGURE 1

*Aggregate Grade Differential (difference between grade 12 and first-year chemistry grades) Distribution for all Ontario Students*

So why do so many students fail despite arriving with excellent high school grades? More importantly, why do they perform poorly in a course (CHM139) that, on paper, overlaps significantly with the high school curriculum taken by the majority of those students? Demographic factors certainly play a role, but seem unlikely to account for the wide spread in grades relative to high school as these will have already contributed to the degree of self-selection associated with the study cohort. For comparison, a recent US study of 12 universities and colleges found that demographic factors made relatively minor contributions compared to academic scores (Tai, Sadler, & Loehr, 2005; Tai, Ward, & Sadler, 2006); yet even the most complete model accounted for only 38% of the inherent variation between students in terms of final grades.

In fact, the relationship between high school and university grades in chemistry (as well as physics, mathematics, and biology) has been studied for over 80 years with broadly similar results: students who do well in college or university chemistry are, on average, more likely to have done well in high school chemistry and mathematics than other students. The converse, however, is not necessarily true. In fact, there is a very poor correlation between actual high school and first-year grades. In the words of one reviewer:

> There is some indication that taking high school chemistry may be used as an indi-

> cator of success in college chemistry. There are indications that a math/physics background, high placement scores, achievement tests scores, intelligence, and age may be better, or at least as good, as indicators. There is also evidence that no indicator is all that accurate. (Ogden, 1976, pp. 125)

Given the parallel extensive research on teaching methods, together with the many reform initiatives launched throughout North America and Europe over the same period, it is disheartening to find that this observation *still* holds true 30 years later.

## Gaining an Education...

Just as there has been a long history of research into the value of high school as preparation for college or university chemistry, so there have been numerous attempts to identify at-risk students and implement appropriate interventions. One recurring theme has been the use of diagnostic and placement tests, combined with either streaming within a single course structure (Cornog & Stoddard, 1925; Everhart & Ebaugh, 1925), or diversion into alternate or supplementary courses (Hovey & Krohn, 1958; Ozsogomonyan & Loftus, 1979; Russell, 1994).

One particularly important aspect of the 1958 study by Hovey & Krohn is the nature of the course to which at-risk students were directed. While this used chemistry as a context, the course emphasized study skills essential to success in any program: reading for comprehension; basic mathematics (algebraic manipulation); use of prior knowledge to interpret observations; and efficient use of study time.

This echoes the theme of alternate research on student success that emphasizes a student's learning style or approach to both learning in general and specific learning tasks. The underlying model is a synthesis of work by Pask, Marton & Säljö, and Biggs, amongst others (see Entwistle, 2010 and references therein). In this context, style refers not to the traditional visual-auditory-kinesthetic categorization, but to a student's assumptions about learning, their intentions, motivation, and orientation (deep *versus* surface, etc.). One outcome of this work is the "approaches and study skills inventory for students" (ASSIST) questionnaire (Entwistle & Ramsden, 1983). This has been used to identify at-risk students during their first semester at college or university (Tait & Entistle, 1996), and test the effectiveness of learning skills interventions (Ramsden, Beswick, & Bowden, 1986). Results from the ASSIST questionnaire and related instruments confirm what many of us would intuitively expect: that a significant – even major – contribution to a successful high school–university transition is the set of study skills a student arrives with, and his/her ability to acquire and adapt those skills as necessary in post-secondary education.

This last point is confirmed by my own study: overwhelmingly, students who felt well-prepared for university commented on their teachers' efforts to instil good study habits and emphasize comprehension over recall. Similarly, students from *Advanced Placement* and *International Baccalaureate* courses described the main advantage of such programs as better preparation for the pace and intensity of university courses, rather than the content knowledge acquired (although the latter certainly helps). On the other hand, conversations with students who have failed first-year chemistry – often for the second or third time – reveal individuals who persist with ineffective study strategies, and often struggle to use basic mathematical skills in other contexts. Students comment frequently that grade 12 should have been more challenging; there is a widespread sense that high school was "too easy" as students often did not have to take responsibility for their own learning. Similar findings are also emerging from the College Mathematics Project, where student discussion panels focused on accountability for learning (Schollen, Orpwood, Sinclair, & Assiri, 2009). Essentially, this includes those abilities and attitudes encompassed in the "Learning Skills" section of the Ontario student report card, but that are expressly *not* included in reported course grades. As Schollen et al. (2009) point out:

> [T]eachers in secondary school and college can profit by a much deeper understanding of the different philosophies of teach-

> ing and learning that underlie their institutions. There are differences … in the ways mathematical concepts are represented in the classroom, there are differences in approaches to instruction and differences in assessment, all of which require students to "change gear" as they move from school to college. The problem for students is that there is nobody to help them make this transition; there is no manual for coping with learning in college.

The same could be said for students moving from high school into *any* post-secondary institution.

## Giving an Education...

What, then, can be done for the significant group of students who struggle with this important educational transition? While high school teachers can emphasize essential learning skills, the demands of an ambitious curriculum and, in some cases, board or school policies that undermine such efforts, are challenging. Yet it is essential that colleges and universities find ways to communicate and work with their high school colleagues – either through general educational discussion groups, participation in teaching conferences, or by offering specific professional development seminars. The importance of this cannot be overstated: although there seems to be little time to teach such skills in high school, there is even *less* time in college or university, where such skills are often assumed on entry.

In fact students also appear to believe they have the necessary skills, until they reach a crisis point during their first year. For example, 75% of students who felt that high school prepared them well nonetheless reported having to re-evaluate their study skills once in university (Stone, 2009). Furthermore, of four survey items related to learning and study skills – an emphasis on memorisation, use of a text book, homework completion, and time management – only the first has a (negative) impact on mean university grades and grade differentials. Indeed, 30% of students who report always completing their homework also admit to procrastinating! The increased pace, content, and reduced number of tests in university makes this an extremely risky practice. High school teachers can help by teaching – and evaluating – note taking and elaboration, problem solving strategies, and reading for comprehension within specific course contexts. College and university faculty can assist by providing suitable examples and problems from overlapping curriculum areas, particularly where students are known to have conceptual difficulties. Where grading concerns exist, a weighted scheme can be applied; students nonetheless benefit from gaining a clearer idea of what will be expected in college or university.

At the post-secondary level, it is clear that early identification of at-risk students through subject-specific pre-tests or general learning skills evaluations is imperative. This is particularly important for those high-enrolment first-year courses such as chemistry that act as "gatekeepers" for a wide range of degree programs. Such students can then be offered appropriate, effective skills programs either as stand-alone courses, supplemental units to existing courses, or components of "stretched" or preparatory courses in relevant subject areas. Alternatively, students can be streamed into tutorial and lab sections that provide greater support to at-risk students. A strong case can also be made for *Foundations for Learning* courses, ideally offered for general credit in the summer and fall sessions (Browning & Le-May Sheffield, 2008).

In the physical sciences, these at-risk students can well be described in Piagetian terms as lacking in formal operational development (Herron, 1975; Laurillard, 2005). This is manifest in the poor mathematical skills noted earlier, as well as difficulty with fundamental concepts and operations; for example, Herron (1975) lists 16 items in introductory college chemistry that challenge such students (p. 148). Referencing other educational frameworks, such students struggle with a surface approach to concepts that intrinsically require a deeper approach for mastery (Entwistle, 2010); and they struggle to move beyond factual knowledge and simple understanding to conceptual and procedural knowledge and higher levels of cognitive processing (Anderson & Krathwohl, 2001). Students accustomed to success on such basic terms may be unaware that higher dimensions of learning exist until they realise – too late – that they simply don't "get it." Frankly, they deserve better. In conclusion, a much greater emphasis needs to be placed on appropriate study skills and formal operational thinking to help these students make the transition from high school to college or university. Higher education should challenge students, but for the right – rather than avoidable – reasons. As one survey respondent wrote:

> I feel my high school teachers prepared me very well for university, even though it was a big jump. Sometimes, change and challenge are nice and necessary for progress. Without challenge, we would all stay stagnant and there would be no scientific, political, social, or personal progress.

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## Biography

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