Why Good Students Fail
(And What We Can Do About It)

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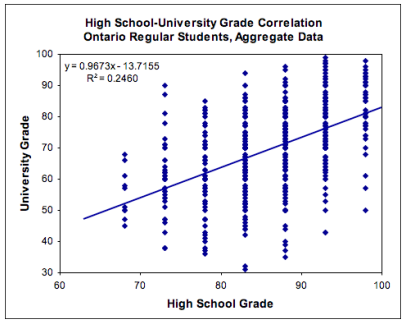
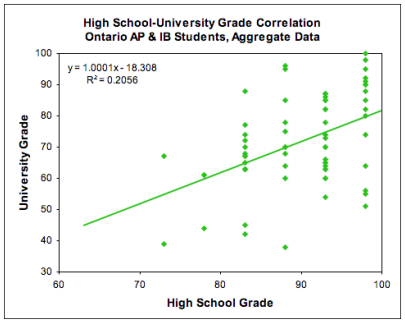
Chemical Education Survey:

- Pilot study in 2006-7
- Main study 2007-8 & 2008-9
- Mixed mode study (qualitative/quantitative)
- ROP299 student team research project

Year	Enrolment	Surveys	Response
2006-7	1830	320	17.5%
2007-8	1803	536	29.3%
2008-9	1723	414	24.0%
Total:	**5356**	**1270**	**23.7%**

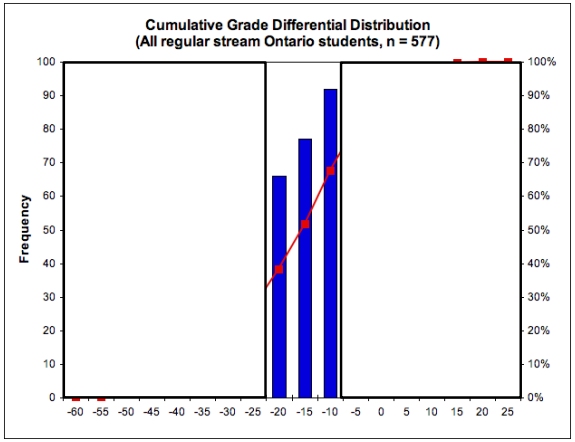
Aggregate Correlations:





- High school grades assigned as central value for each range
- Data for missing high school/university grades omitted
- Data for Ontario students who wrote 1st-year final exam only
- Regular stream n = 584; AP n = 39; IB n = 28

Grade Differential (Aggregate):



GD = Uni – HS

Regular:
–16.7 ± 13.7
AP:
–15.5 ± 12.7
IB:
–20.3 ± 14.2
CHM138:
–15.7 ± 13.8
CHM139:
–18.3 ± 13.5

Ontario Grading Policy:

- The 70/30 Rule
  - Final evaluation 30% of course grade
- KICA (assessment breakdown)
  - Knowledge & Understanding
  - Inquiry & Thinking
  - Communication
  - Application & Making Connections
- Late penalties discouraged
- No exam board (except IB and AP programs)

TDSB Grading Policy:

- The 70/30 Rule
  - Final 30% evaluation *should* be subdivided
- KICA (assessment breakdown)
  - 20–30% range for each in science
- Consideration for missed assignments
  - 'Zero' grades discouraged
- Coursework grades *basis* for assigned grades
  - assessment *vs.* evaluation

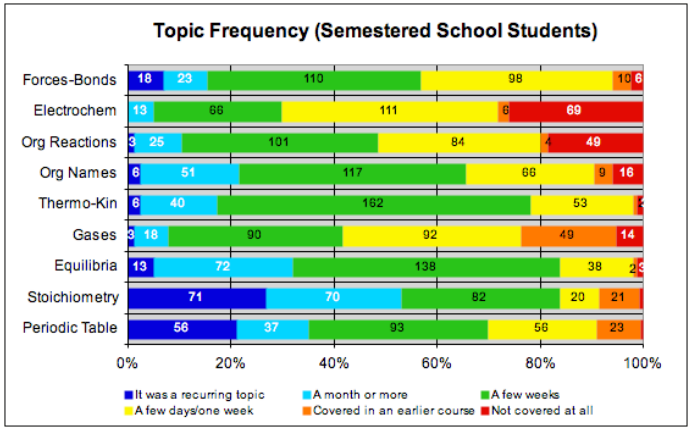
Source: "Fresh AER", TDSB, 2006

Grading Scheme Comparison:

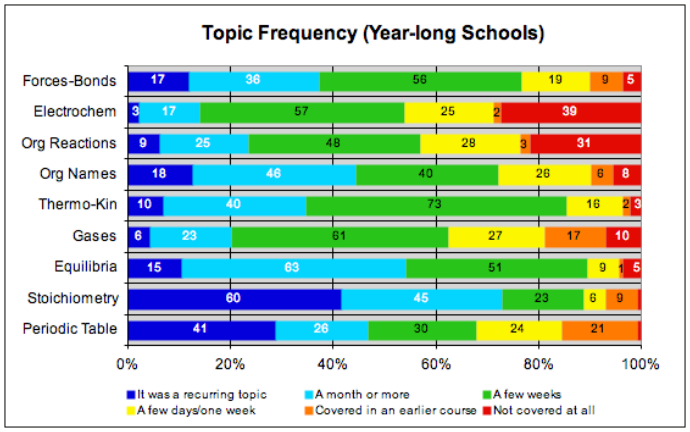
Item	High School[1]	University[2]
Quizzes	13% (12)	2.5% (6)
Tests	34% (9)[3]	40% (2)
Assignments	4% (2)	2.5% (6-12)
Labs	18% (6)	20% (5)
Term work	**70%**	**65%**
Final exam	**30%**	**35%**

1. Grade 12 academic, ~36 weeks (year-long)
2. CHM139F, 13 week semester
3. One mid-course cumulative test

Topical Content - Semestered



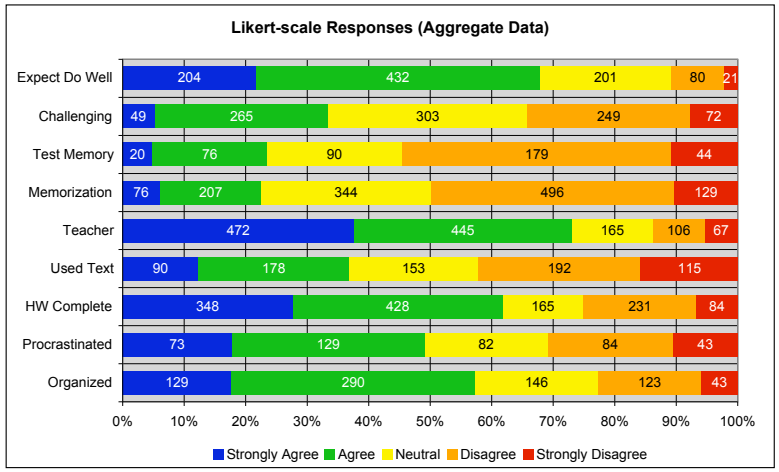
Topical Content - Year-long



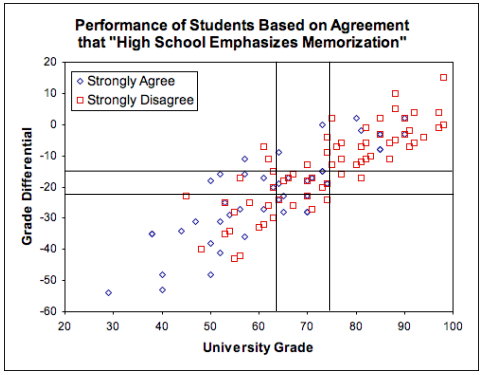
Student Perceptions - School:

1. I expect to do well in university chemistry
2. I found high school chemistry challenging
3. Tests emphasized memorization
4. Classes emphasized memorization
5. My teacher performed effectively
6. I used the text extensively
7. I always completed homework
8. I procrastinated a lot
9. I was organized and used my time effectively

Student Perceptions - School:



High School Memorization:



Statistical tests:

- Same mean high school grades ($p > 0.01$)
- Different mean university grades ($p < 0.0001$)
- Different mean GDs ($p < 0.001$)

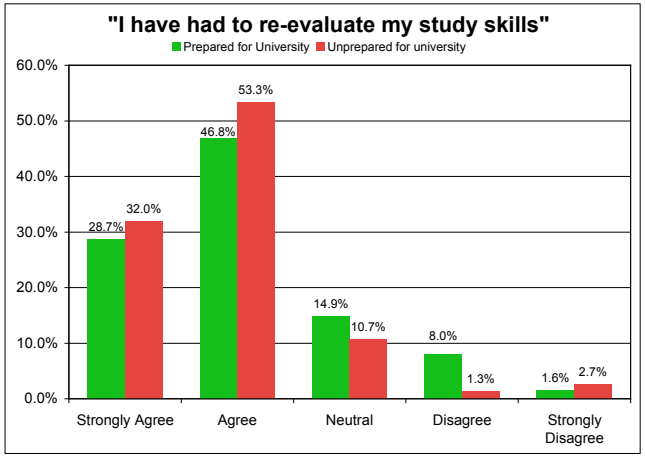
- Students who feel that high school emphasizes memorisation tend to do worse in university

Other High School Habits:

Comparison of results for extreme response groups
(*t*-test of means, unequal variance)

Category	Mean HS Grade	Mean Uni Grade	Mean GD
Time Management	Different $p < 0.005$	Same $p >> 0.01$	Same (?) $0.01 < p < 0.05$
Homework Completion	Different $p < 0.005$	Same $p >> 0.01$	Same $p >> 0.01$
Used Text	~Different $p = 0.0099$	Same $p >> 0.01$	Same $p > 0.05$

Student Study Skills:



Learning How To Learn:

"I think the difficulty of university chemistry is overrated. […] As I have learned how to learn already, for me, university has simply meant a more diligent approach..."

"There are differences [in how] concepts are represented in the classroom ... approaches to instruction and [...] 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."

Schollen et al, College Mathematics Project Final Report 2008

Diagnostics - Style/Skills:

Approaches & Study Skills Inventory for Students (ASSIST)

Deep	Surface
Strategic	Apathetic

- *I manage to find conditions for studying which allow me to get on with my work easily*
- *When working on an assignment, I'm keeping in mind how best to impress the marker*
- *I usually set out to understand for myself the meaning of what we have to learn*
- *I find I have to concentrate on just memorising a good deal of what I have to learn*

Intellectual Development:

- Piaget
  - Concrete operational
    - classification, conservation, decentering, seriation, reversibility, transitivity
  - Formal operational
    - control of variables, combinatorial reasoning, correlational reasoning, hypothetical-deductive reasoning, probablistic reasoning, proportional reasoning
- Vygotsky
  - Language, culture, societal factors
  - Zone of proximal development

Intellectual Development:

- Related modern "takes"
  - Scientific reasoning (Steussy)
  - Rationality quotient (Stanovich, Toplak)
    - Cognitive miser (fastest solution)
    - Mindware gap (logic, probability, inference)

Conclusions:

- College/university entry diagnostics
  - Streaming (where possible/appropriate)
  - Supplemental instruction
  - Increased tutorial/lab support *as needed*
- Explicit teaching of relevant study skills
- Sequencing of topics, approaches
- Teach and assess for understanding

The ROP299 Teams:

2006-7:

Robin Baj
Michael Lebenbaum
Sujan Saundarakumaran
Derrick Tam
Jakub Vodsedalek

2007-8:

Mena Gewarges
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Jana Pfefferle
Curtis Wang

2008-9:

Marlena Colasanto
Lauren Cosolo
Darrin Gao
Inna Genkin
Kelly Hoang
Justina Lee
Bryan Nguyen
Emily Plobner

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