"How well does high school prepare you for university chemistry?"

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with

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A CHM 299Y Research Opportunity Project

Relevant Literature

Survey of 12 US colleges & universities:

- R. H. Tai, P. M. Sadler, and J. F. Loehr
  - *J. Res. Sci. Teaching*, 2005, *42(9)*, 987-1012
- R. H. Tai, R. B. Ward, and P. M. Sadler
  - *J. Chem. Ed.*, 2006, *83(11)*, 1703-1711

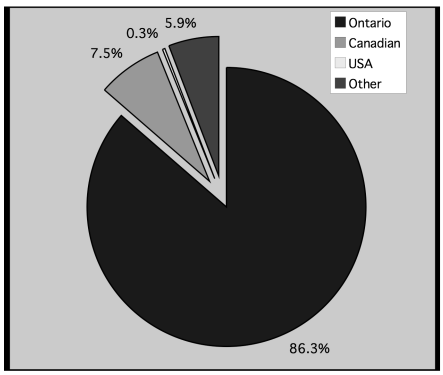
Ontario survey & interviews:

- L. Jones, University of Guelph
  - *"Surviving Killer Chem", STAO 2006, Toronto*

Survey Cohort Data

- Students registered in *any* 1st-year chemistry course during 2006-7 (CHM138/139/151)
- 1830 eligible students in BlackBoard™
- Survey on-line during Spring 2007 session
- 320 completed surveys submitted (17.5%)
- 3 Focus groups held (March 2007)

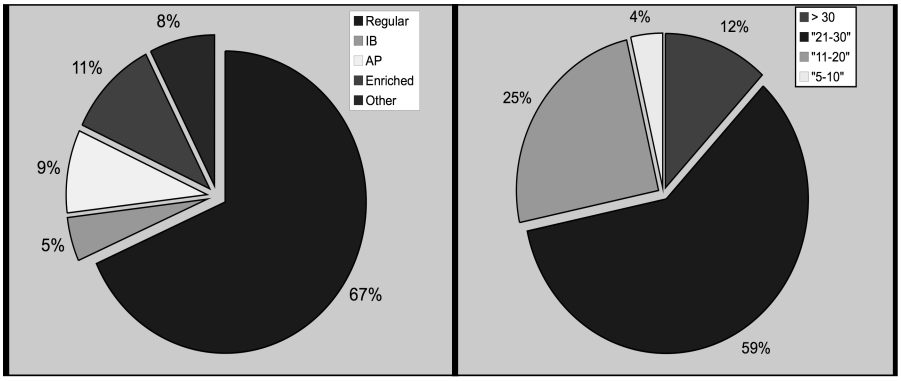
The Schools Represented:



123 different schools:

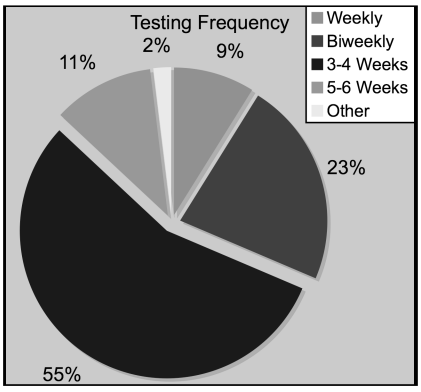
- 81 in Ontario
- 22 in rest of Canada
- 20 international
- 75 public schools
- 23 Catholic schools
- 25 private schools

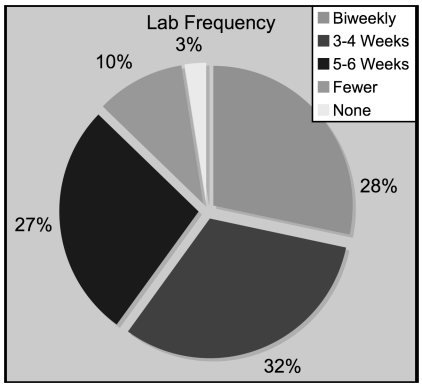
Student Class Profiles



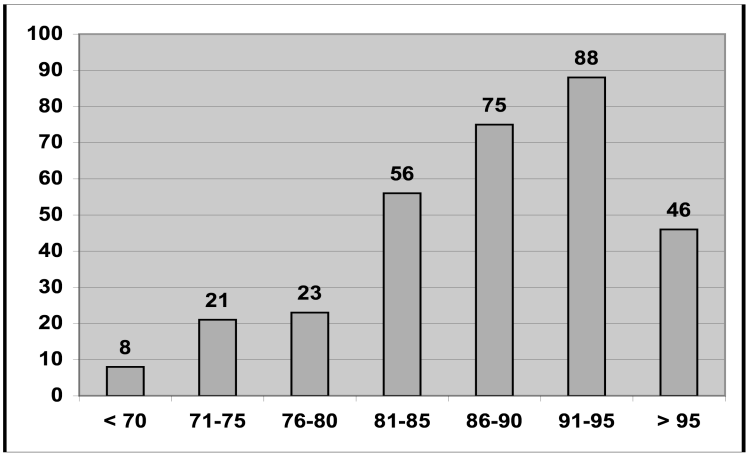
- 58% completed an independent study unit in high school

School Labs and Evaluation

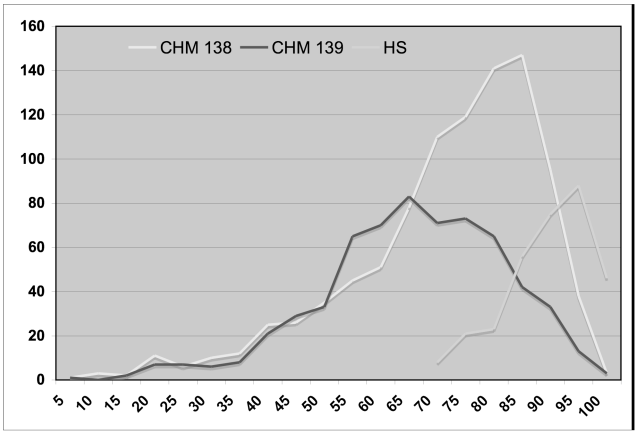




Student Grade Distributions



Comparison with CHM 1xx



- CHM 138
  - ave. 69.7
  - $n = 959$
- CHM 139
  - ave. 63.8
  - $n = 633$
- Global HS:
  - ave. 87.4

Results for Fall 2006 session; HS entry average for 2005-6

The Grade Point "Hit"

- Students typically warned to expect a 10 point drop in average grade
- Very few believed it...
- Some fared much worse...

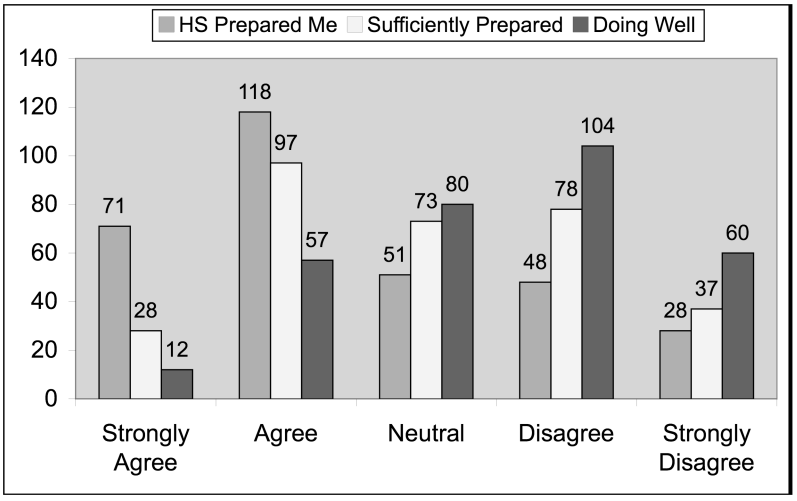
"I felt that I was at a major disadvantage because I graduated from a different province. To graduate chem 12 with a 95% and then to fail the first chm 139 midterm that was supposed to be "review" was very upsetting"

Student impressions

1. "My high school experience helped prepare me for university"
2. "I feel high school sufficiently prepared me for university"
3. "I am doing as well as I expected in university chemistry"

Answered on a 5-point Likeart scale: "Strongly Agree", "Agree", "Neither Agree nor Disagree", "Disagree", "Strongly Disagree"

Student impressions



High School Programs

Advanced Placement (AP):

- Offered by 180 out of 545 schools in Ontario in 2006 (source http://www.ap.ca/)
- Program continues to expand

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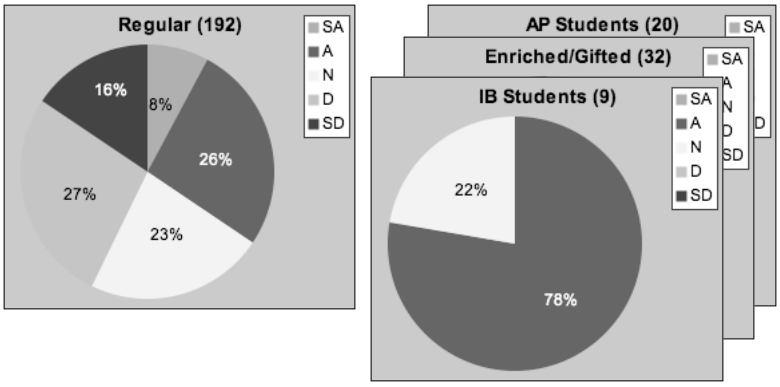
International Baccalaureate (IB):

- Offered by 45 schools in Ontario
- Includes 37 public schools (source http://www.ipo.org/)

Do AP/IB Students Gain An Advantage?

(Did high school sufficiently prepare you?)



(Data for Ontario students only)

Do AP/IB Students Gain An Advantage?

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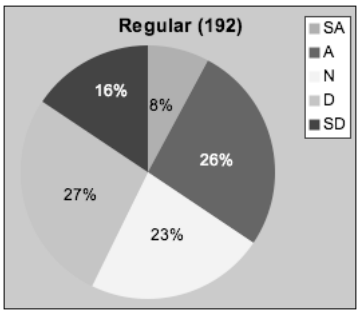

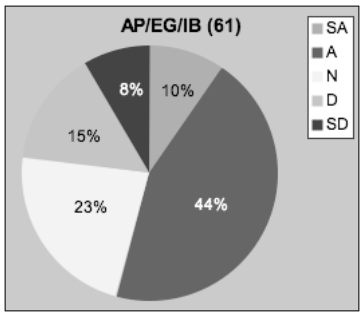

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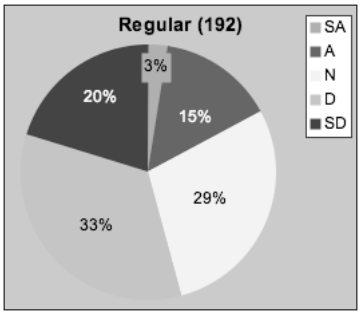
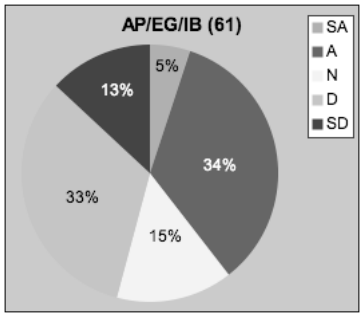
Do AP/IB Students Gain An Advantage?

(Are you doing as well as expected?)





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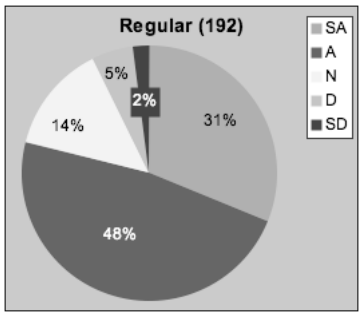
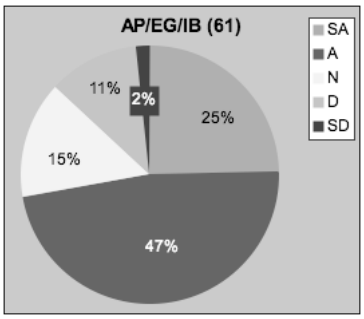
Do AP/IB Students Gain An Advantage?

(I have had to re-evaluate my study skills)





(Data for Ontario students only)

Changes From High School

- The Pace
  - more information covered in shorter time
  - fewer evaluations covering more material
  - tests for multiple courses compressed into short time

"The university pace is quite a lot faster, and it requires a lot of motivation on your part and independent learning."

"I found that my time management skills were the only thing that was keeping me alive."

Changes From High School

- Readings
  - easy to fall behind, hard to catch up
  - much greater emphasis on independent study

"A lot more reading than we used to have to do."

"Not everything is going to be covered in the lectures"

"I expected a lot of reading, but not as much ... Wow, that's a lot of reading!"

"The most important difference: if you fall behind, you stay behind."

Changes From High School

- Learning Emphasis
  - abrupt transition from memorization to understanding

"In high school, the hoops we had to jump through were more memorizational and less conceptually based (i.e. one could get an A without knowing chemistry"

"They [high school] showed you a breakdown, and they show you that your memorization is worth more on tests than your actual application"

Changes From High School

- Curriculum and testing
  - different style of questions
  - timing of more complex material

"[Lecturers] spend a lot of time dealing with easy things but near mid-terms introduce things that ... need time to explain, which they don't have"

"I feel that the homework problems are not within the same realm as the questions on the tests"

"High school does not give much preparation for taking multiple choice tests"

" Questions on high school tests involving higher thinking are rare."

Changes From High School

- Quality and quantity of labs
  - unaccustomed to duration, required preparation, formal reports
  - more varied, complicated, use of equipment
  - lack of timely and appropriate feedback

"The lab manuals were hard to comprehend..."

"[Labs] do very little to solidify facts that we learned in class – especially when we are graded on our yield"

"I don't think I get too many explanations about the labs, especially after they're done - I got my mark, and that was it"

High School Preparation - Bad

"Grade 11 and 12 chemistry prepared me extremely inadequately for organic chemistry, but prepared me extremely well for physical chemistry"

"High school prepared me for university in as much as allowing me to realize that no one really cares if you do an assignment or not, learning is for yourself and yourself alone"

"I find that high school chemistry does not prepare you fully for university. My high school chemistry class was a joke."

High School Preparation - Good

"I feel my high school teachers prepared my very well for university, even though it was a big jump. Sometimes, change and challenge are nice and necessary for progress."

"I actually really didn't like my high school chemistry teachers, like I didn't really just like their attitude towards us. I didn't feel they were very helpful; but the curriculum high school chemistry I think is really good, like I feel more prepared for chem than for any other class here."

Recommendations - Tests

- "Rate" questions according to type, difficulty
- More problem-solving questions for homework & tutorials, also on-line
- Provide feedback on more complex problems
- Increase student awareness of past exams, help sessions, *etc*.

Recommendations - Labs

- Unclear instructions – hard to read/understand
  - simplify language (many ESL students)
  - use simple diagrams and pictures*
  - use multimedia approach
  - on-line pre-lab quiz with immediate feedback

* P. Dechsri, L. L. Jones, and H. W. Heikkinen, *J. Res. Sci. Teac.*, 1997, *34(9)*, 891-904

Recommendations - Labs

- Lack of meaningful, timely feedback
  - on-line questions/reports?
  - code for common errors mistakes
  - improve TA training to address consistency
- Unclear connection to lectures
  - mention specific experiments ***in lectures***

Recommendations - General

- Spread out announcements regarding resources, study help, *etc*.
  - students overloaded with information in first week
- Emphasize differences from high school in learning communities and tutorials
- Introduce advanced concepts earlier in curriculum (*i.e*. spread content out more)
- Better communication with high schools regarding university practices & expectations