Study Skills and Success in Science

Zits, by Jerry Scott and Jim Borgman, November 6th 2010
http://www.arcamax.com/zits/

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The first-year experience:

Cumulative High School–University Grade Correlation
Ontario Regular Students ($n = 826$)

$y = 0.9222x - 10.16$
$R^2 = 0.2406$
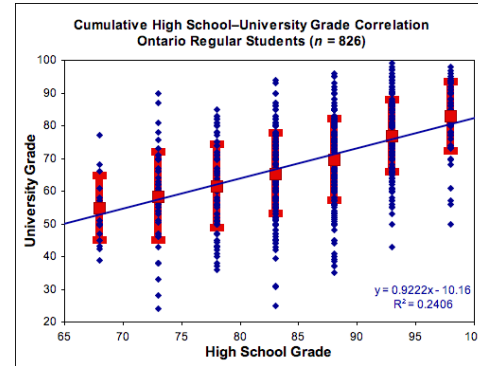
- 1st year chemistry
- 2006-2010 surveys
- WD & DNW omitted
- HS mean = 86 ± 7
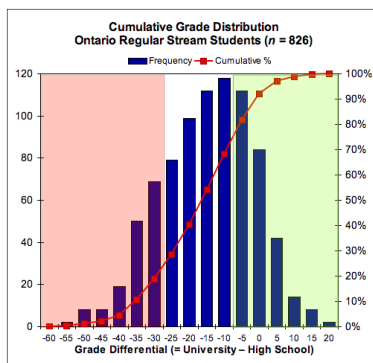- Uni mean = 69 ± 14
- Mean Uni *vs.* HS $R^2 = 0.9752$

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The first-year experience:

Cumulative Grade Distribution
Ontario Regular Stream Students ($n = 826$)

Aggregate student data for 2006–2010 (WD and DNW omitted)

- **Overall**:
  - GD = -17 ± 13
- **Upper quartile**:
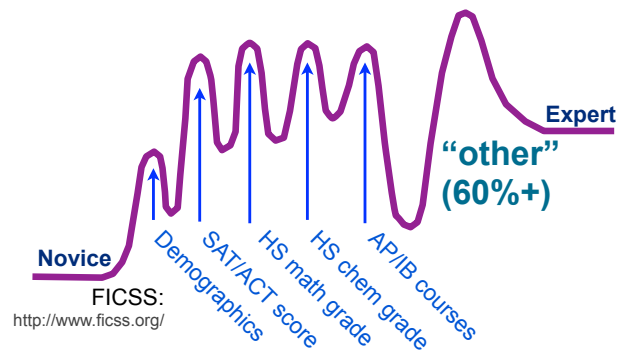 - GD = -9 to $+20$
- **Lower quartile**:
  - GD = -60 to -30

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Pathways & barriers to success:

Expert

"other" (60%+)

Novice

Demographics
SAT/ACT score
HS math grade
HS chem grade
AP/IB courses

FICSS:
http://www.ficss.org/

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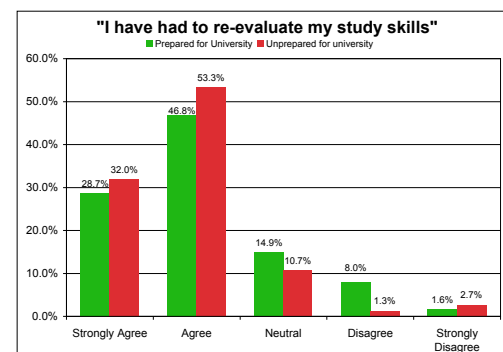
Explaining the "other":

- Alternative conceptions (misconceptions)
- Intellectual development (Piaget/Perry)
- Learning style (approach, aptitude)
- Perceived learning environment
- Problem-solving skills
- Effective study habits
- Temperament/personality

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Student study skills:

"I have had to re-evaluate my study skills"
Prepared for University / Unprepared for university

Strongly Agree: 28.7% / 32.0%
Agree: 46.8% / 53.3%
Neutral: 14.9% / 10.7%
Disagree: 8.0% / 1.3%
Strongly Disagree: 1.6% / 2.7%

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Slide 7

Ways of learning:

Student intention

Achieving — Meaning — Orientation — Reproducing

Goal-driven — Intrinsic — Motivation — Extrinsic

Strategic — Deep — Style — Surface

Instructional practices

Teaching — Content

Approach to content
Strategy · Process
& learning tasks

Assessment — Workload

Outcome (quality)

Deep ↕ Understanding ↕ Surface

http://www.chem.utoronto.ca/~dstone/Research/bibliography.html

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Slide 8

ASSIST Inventory (Entwistle *et al*):

Deep, Strategic | Surface, Apathetic

Deep | Strategic | Surface

| Relating ideas | Using evidence | Time management | Organized studying | Fear of failure | Rote memory |

| Interest in ideas Monitoring understanding | Alertness to assessment & monitoring studying | Syllabus-bound focus on minimum requirements |

| Intention to seek meaning for yourself | Intention to achieve the highest grades | Intention to cope minimally with requirements |

http://www.etl.tla.ed.ac.uk/questionnaires/ASSIST.pdf

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Slide 9

ASSIST Local validation:

ASSIST Factor Loadings (13 Sub-scale items)

Legend: ● Deep ■ TM+OS ■ ME+AO+AA ▲ Surface

Deep sub-scales: UE, RI, II, SM

ME, AO, AA

Strategic sub-scales: OS, TM

Surface sub-scales: FF, UM, SB, LP

Axes: Factor 1 (−0.200 to 1.000), Factor 2 (−0.400 to 0.800)

Cronbach α:
- 403 responses
- 52 items
- 13 sub-scales
  ‣ 0.63 – 0.81
- 3 main scales
  ‣ 0.87 – 0.93

Factor analysis:
- 403 responses
- 13 sub-scales
- 3 factor solution
- 50.5% of variance
- χ^2 = 154 ($p \ll 10^{-4}$)

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Slide 10

ASSIST Main scale correlations
• Pearson's *r* values:
– 1st-year chemistry students (life sciences), *n* = 394

| Scale:	Deep	Strategic	Surface
1st-year	0.1960	0.2859	**−0.4060**
Deep		**0.4561**	**−0.3545**
Strategic			−0.2528

All *r* values statistically significant @ 99.99% CL ($p < 10^{-4}$)

$$t = \frac{|r|\sqrt{n-2}}{\sqrt{1-r^2}}; \; H_0\,(r=0)$$

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Slide 11

ASSIST Scores and grades

Distribution of Main Scale Scores

Legend: Students | Deep | Strategic | Surface

Y-axes: Score (%) 35%–95%, and 0%–30%
X-axis: First year grade range: 91-100, 81-90, 71-80, 61-70, 51-60, 41-50, 0-40

Mean normalised scores by grade range for 1st-year chemistry students (life sciences) *n* = 394; error bars are ±1 s.d.

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Slide 12
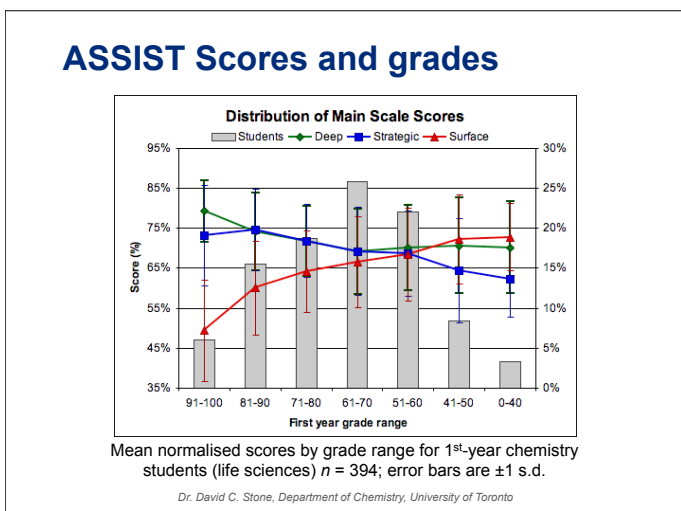
ASSIST Deep scale correlations
• Correlation with 1st-year grade:

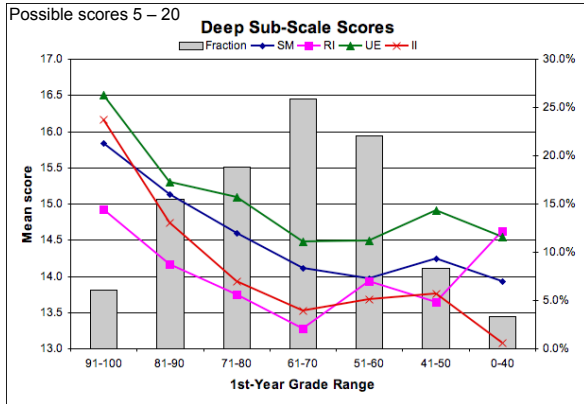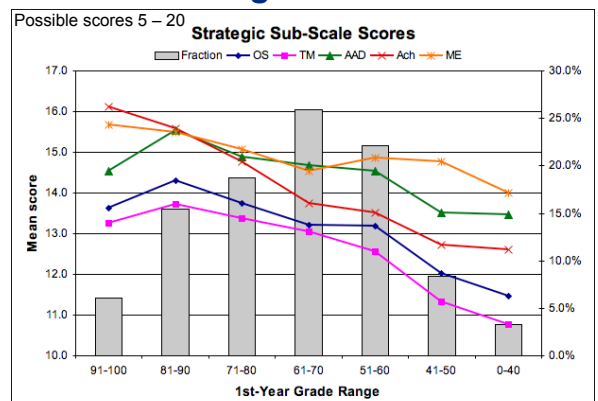| Sub-scale	*r*	Comment
Deep	0.1960	weak*
Seeking meaning	0.1962	weak**
Interest in ideas	0.1850	weak**
Use of evidence	0.1719	weak**
Relating ideas	0.0622	none

* *r* values statistically significant @ 99.99% CL ($p < 10^{-4}$)
** *r* values statistically significant @ 99.9% CL ($p < 10^{-3}$)

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Slide 13

ASSIST Deep scale:

Possible scores 5 – 20

Deep Sub-Scale Scores

Legend: Fraction · SM · RI · UE · II

Y-axis (left): Mean score (13.0–17.0); Y-axis (right): 0.0%–30.0%
X-axis: 1st-Year Grade Range (91-100, 81-90, 71-80, 61-70, 51-60, 41-50, 0-40)

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Slide 14

ASSIST Deep scale

- Specific questions impacting grades
  - Positive correlation with grade:
    - When I'm reading an article or book, I try to find out for myself exactly what the author means (SM)
    - It's important for me to be able to follow the argument, or to see the reason behind things (UE)

  - Negative correlation with grade
    - When I'm working on a new topic, I try to see in my own mind how all the ideas fit together (RI)

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Slide 15

ASSIST Strategic correlations

- Correlation with 1st-year grade:

| Sub-scale	r	Comment
Strategic	0.2859	medium*
Achieving orientation	0.3782	strong*
Organised studying	0.2148	medium*
Time management	0.1942	weak**
Alert to assessment	0.1645	weak
Monitoring effectiveness	0.1506	weak

* r values statistically significant @ 99.99% CL ($p < 10^{-4}$)
** r values statistically significant @ 99.9% CL ($p < 10^{-3}$)

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Slide 16

ASSIST Strategic scale

Possible scores 5 – 20

Strategic Sub-Scale Scores

Legend: Fraction · OS · TM · AAD · Ach · ME

Y-axis (left): Mean score (10.0–17.0); Y-axis (right): 0.0%–30.0%
X-axis: 1st-Year Grade Range (91-100, 81-90, 71-80, 61-70, 51-60, 41-50, 0-40)

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Slide 17

ASSIST Strategic scale

- Specific questions impacting grades
  - Positive correlation with grade:
    - I feel that I'm getting on well, and this helps me put more effort into the work (AO)
    - I go over the work I've done carefully to check the reasoning and that it makes sense (ME)
    - I work steadily through the semester, rather than leaving it all until the last minute (TM)
    - I keep an eye open for what lecturers seem to think is important and concentrate on that (AA)
    - I'm pretty good at getting down to work whenever I need to (TM)

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Slide 18

Time management

- "I work best under pressure" – BUSTED!

http://http-server.carleton.ca/~tpychyl/carpe_diem/cartoons.html

http://www.procrastination.ca/
http://www.procrastinatorsdigest.com/

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ASSIST Surface scale correlations

• Correlation with 1st-year grade:

Sub-scale	r	Comment
Surface	−0.4060	strong*
Unrelated memorising	−0.3722	strong*
Fear of failure	−0.3322	strong*
Lack of purpose	−0.3028	strong*
Syllabus bound-ness	−0.2177	medium*

* r values statistically significant @ 99.99% CL ($p < 10^{-4}$)
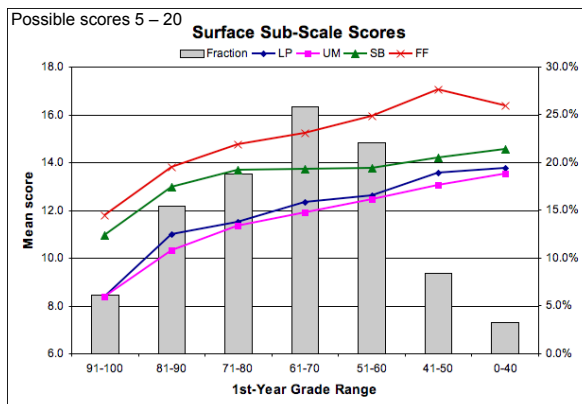
ASSIST Surface scale

Possible scores 5 – 20

ASSIST Surface scale

• Specific questions impacting grades
  – Negative correlation with grade
    • I'm not really interested in this course, but I have to take it for other reasons (LP)
    • I'm not really sure what's important in lectures so I try to get down all I can (UM)
    • I often have trouble making sense of the things I have to remember (UM)
    • There's not much of the work here that I find interesting or relevant (LP)
    • Often I feel I'm drowning in the sheer amount of material we're having to cope with (FF)
    • Much of what I'm studying makes little sense: it's like unrelated bits and pieces (UM)
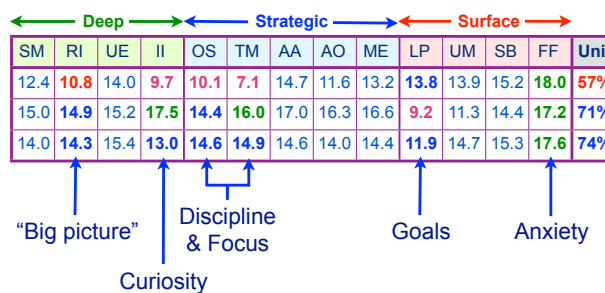

ASSIST Cluster analysis

• k-means grouping into 24 clusters:
  – groups students with similar "traits"

	Deep				Strategic					Surface			
SM	RI	UE	II	OS	TM	AA	AO	ME	LP	UM	SB	FF	Uni
12.4	10.8	14.0	9.7	10.1	7.1	14.7	11.6	13.2	13.8	13.9	15.2	18.0	57%
15.0	14.9	15.2	17.5	14.4	16.0	17.0	16.3	16.6	9.2	11.3	14.4	17.2	71%
14.0	14.3	15.4	13.0	14.6	14.9	14.6	14.0	14.4	11.9	14.7	15.3	17.6	74%

"Big picture" (RI) Curiosity (II) Discipline & Focus (OS, TM) Goals (LP) Anxiety (FF)

"Dissonance in study orchestrations" (Jan Meyer *et al*)

Student perceptions - school:

I expect to do well in university chemistry
I found high school chemistry challenging
Tests emphasized memorization
Classes emphasized memorization
My teacher performed effectively
I used the text extensively
I always completed homework
I procrastinated a lot
I was organized and used my time effectively

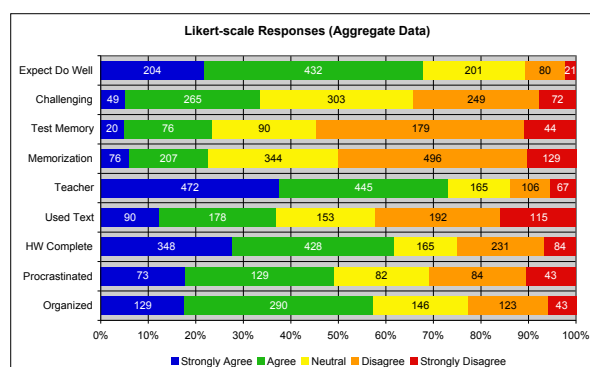http://www.chem.utoronto.ca/~dstone/Research/survey.html

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Student perceptions - school:

Likert-scale Responses (Aggregate Data)

http://www.chem.utoronto.ca/~dstone/Research/survey.html

High school memorization:

Performance of Students Based on Agreement that "High School Emphasizes Memorization"
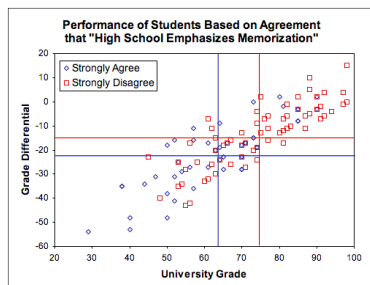
Statistical tests:
- Same mean high school grades
  ($p > 0.01$)
- Different mean university grades
  ($p < 0.0001$)
- Different mean GDs
  ($p < 0.001$)

- Students who felt that high school emphasized memorisation tend to do <u>worse</u> in university chemistry

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High school habits:

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

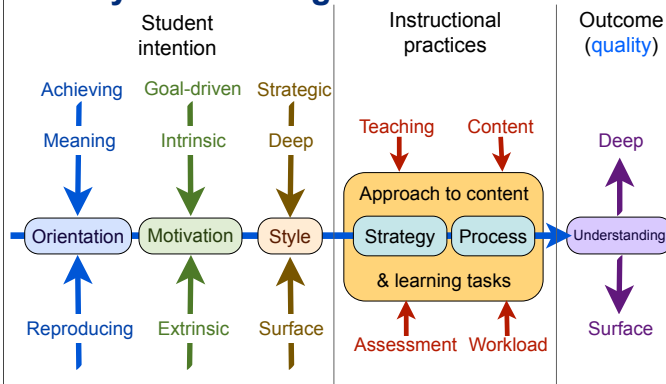| Category	Mean HS Grade	Mean Uni Grade	Mean GD
Time Management	Different $p < 0.005$	Same $p \gg 0.01$	Same (?) $0.01 < p < 0.05$
Homework Completion	Different $p < 0.005$	Same $p \gg 0.01$	Same $p \gg 0.01$
Used Text	~Different $p = 0.0099$	Same $p \gg 0.01$	Same $p > 0.05$

Ways of learning redux:

Student intention — Instructional practices — Outcome (quality)

Achieving / Goal-driven / Strategic
Meaning / Intrinsic / Deep
Orientation — Motivation — Style
Teaching / Content
Approach to content — Strategy — Process — & learning tasks — Understanding — Deep
Reproducing / Extrinsic / Surface
Assessment / Workload
Surface

http://www.chem.utoronto.ca/~dstone/Research/bibliography.html

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Study skills catch 22:

- **High school**
  "Not explicitly teaching study skills since there is only time for curriculum content"
- **University**
  "Not explicitly teaching study skills since students must have them as they gained admission"

Tait & Entwistle, *Higher Education*, **1996**, *31*, 97-116

Student Academic Success Centres
Student Academic Writing Centres
Facilitated Peer Study Groups

Research teams:

- **2006-7:**
  - Robin Baj, Michael Lebenbaum, Sujan Saundarakumaran, Derrick Tam, & Jakub Vodsedalek
- **2007-8:**
  - Mena Gewarges, Cindy Hu, Gordon Ng, Jana Pfefferle, and Curtis Wang
- **2008-9:**
  - Marlena Colasanto, Lauren Cosolo, Darrin Gao, Inna Genkin, Kelly Hoang, Justina Lee, Bryan Nguyen, and Emily Plobner
- **2010-11:**
  - Shirin Dason, Xi Nuo Gao, James Hong, Jing Lu, He Zhen Ren, and Heba Shamsi

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