Mapping an integrated course in experimental chemistry

Kerry J. Knox,[1,2] Joshua Bates,[1] Guillaume Bussiere,[1] Vishakha Monga,[1] Christine Rogers,[1] José Rodríguez Núñez[1]

and Robin Stoodley[1]

[1]Department of Chemistry, UBC

[2]Carl Wieman Science Education Initiative

CHEM 315|325|335|345: Integrated chemistry laboratories

- Comprises all of the third-year laboratory instruction offered by the Department of Chemistry
- ~350 students
- ~1/3 Chemistry majors, 1/3 Biochemistry majors, 1/3 BMLS & CMS
- Two semester-long course for Chemistry and Biochemistry students
- Recently integrated to bring four distinct lab courses into one

Examples of course objectives relating to interdisciplinarity

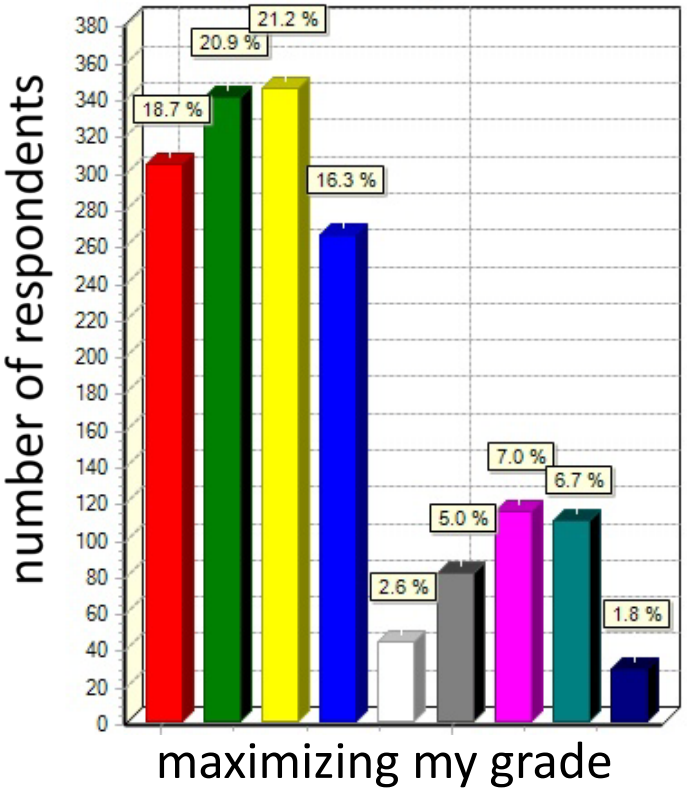
D2. Develop awareness of the interdependence of the traditional sub-disciplines of chemistry.

"…future chemical innovation will require an understanding of the potential contributions of each of the sub-disciplines to solve a given problem."

D3. Become comfortable in an interdisciplinary research environment.

"…This course aims to prepare you for this "interdisciplinary future", for example by encouraging you to appreciate that procedures are driven by scientific need and not by available equipment or disciplinary traditions."

Challenge of choice



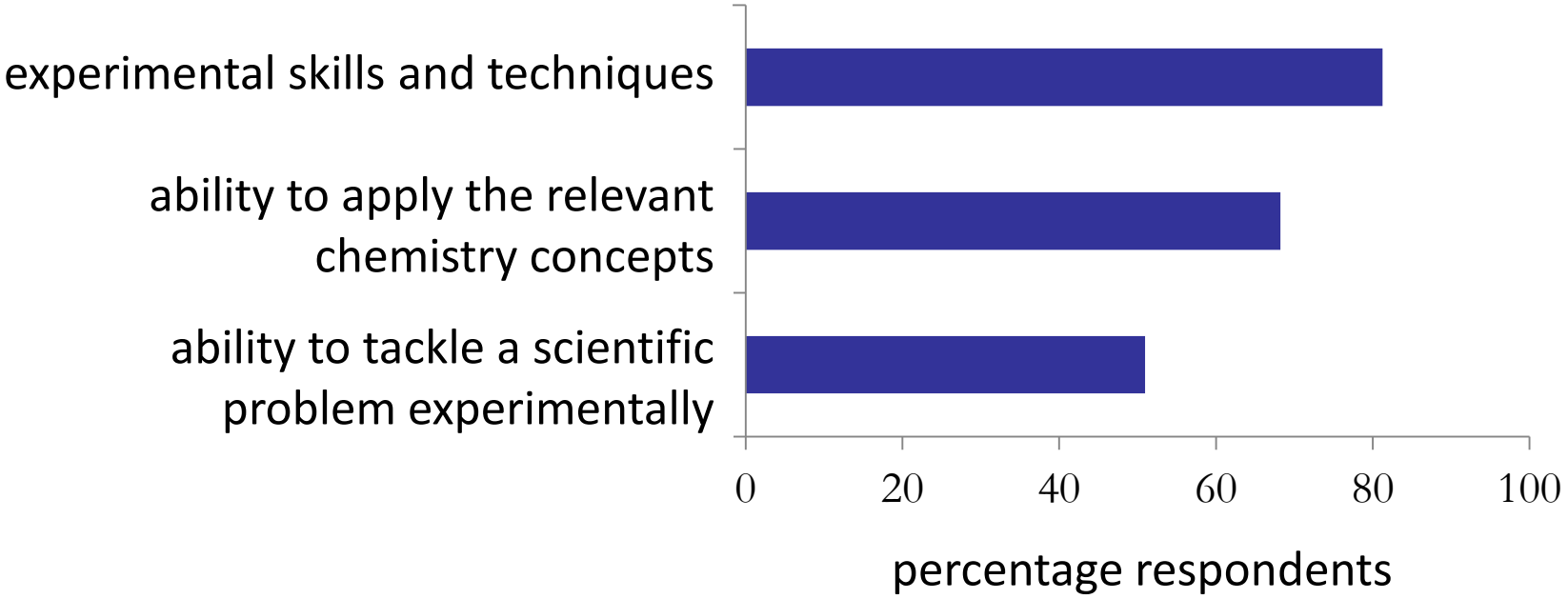
"Rank the top four of the following factors in terms of the extent to which they influenced your choice of experiments"

Skills and knowledge mapping

- Mapping skills and knowledge forming pre-requisites, taught or practiced in the ~ 60 experiments/labs. offered
- To identify unreasonable cognitive demands on students (e.g. several new skills and/or concepts introduced during one experiment)
- To provide guidance to students for choosing an experiment and experiment sequence
- To inform development of new experiments
- To map skills and knowledge progression desired from 1^{st} – 4^{th} year

Complex learning environment

"Indicate whether, in your opinion, the third-year laboratory course at UBC helped you to develop the following capabilities"



Cognitive task mapping

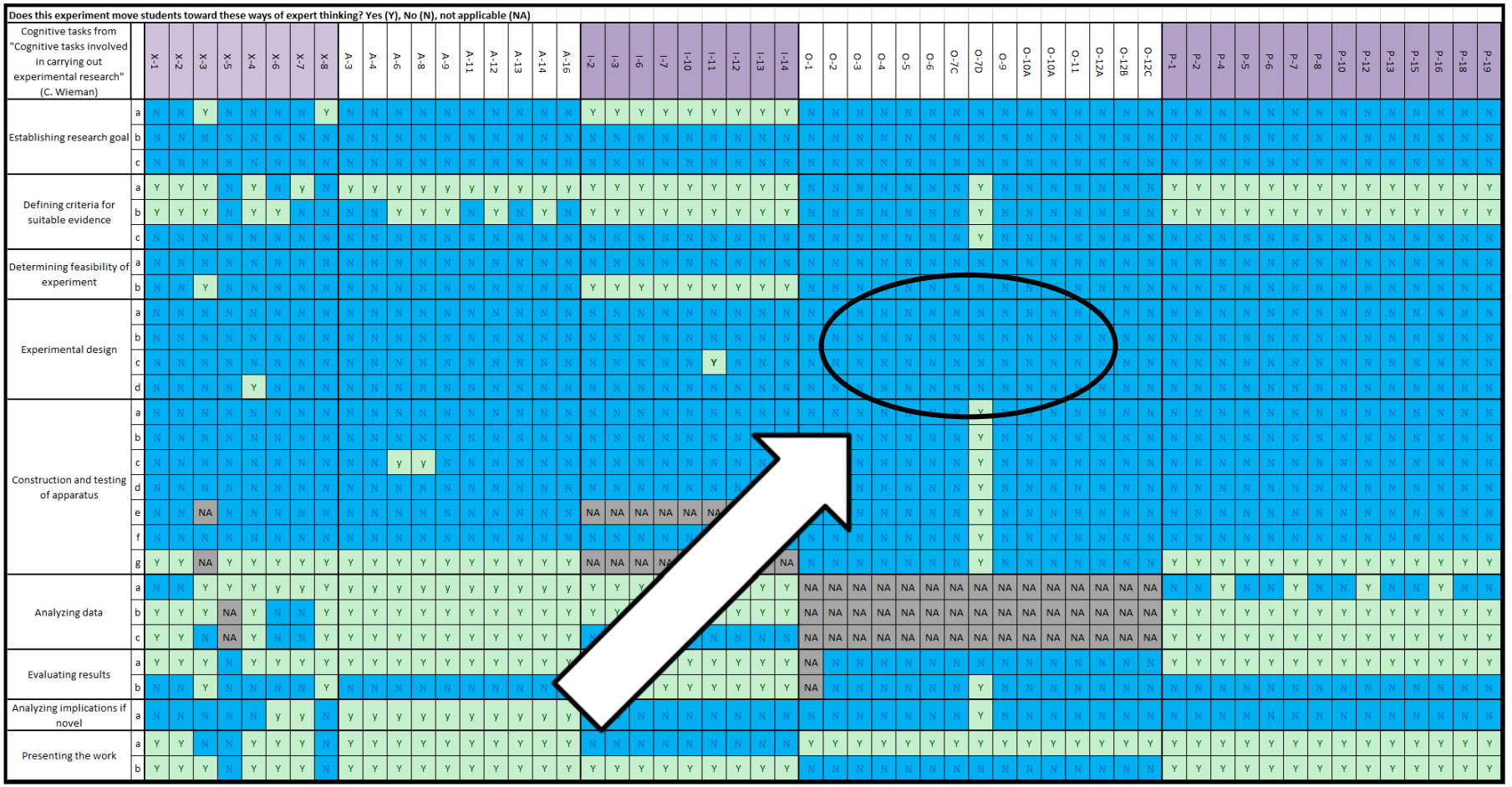
experiments/labs.

cognitive tasks

Does this experiment move students toward these ways of expert thinking? Yes (Y), No (N), not a													
Cognitive tasks from "Cognitive tasks involved in carrying out experimental research" (C. Wieman)		X-1	X-2	X-3	X-5	X-4	X-6	X-7	X-8	A-3	A-4	A-6	A-8	A-9
Establishing research goal	a	N	N	Y	N	N	N	N	Y	N	N	N	N	N
	b	N	N	N	N	N	N	N	N	N	N	N	N	N
	c	N	N	N	N	N	N	N	N	N	N	N	N	N
Defining criteria for suitable evidence	a	Y	Y	Y	N	Y	N	y	N	y	y	y	y	y
	b	Y	Y	Y	N	Y	Y	N	N	N	N	Y	Y	Y
	c	N	N	N	N	N	N	N	N	N	N	N	N	N
Determining feasibility of experiment	a	N	N	N	N	N	N	N	N	N	N	N	N	N
	b	N	N	Y	N	N	N	N	N	N	N	N	N	N

C. E. Wieman, “Cognitive tasks involved in carrying out experimental research”

Cognitive task mapping: The big picture



area of focus for 2014/15

Future directions

Pre- and post- measures collected:

- Attitudes: Full set of CLASS[1] subscales

Post- measures that will be collected:

- SALG-style items with respect to interdisciplinarity, research-like experience
- Student perceptions of opportunities to practice cognitive tasks in experimental design, research-like experience

Expertise in experimental design in organic chemistry:

- Define[2]
- Design laboratory learning experiences to target this

TA roles:

- Observations to understand interaction between pedagogy and TA/student interactions

[1]J. Barbera *et al*., *Journal of Chemical Education*, 2008, **85**, 1435A
[2]D. L. Lafarge *et al*., *Journal of Chemical Education*, 2014, **91**, 173

Acknowledgements

Jackie Stewart	Director: CWSEI in Chemistry
Tamara Kunz	Development of learning objectives
Ido Roll	Mapping inspiration and guidance
Jared Stang	Laboratory observation guidance and tools