Learning Task Inventories (LTIs) in Introductory Organic Chemistry

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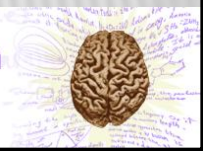
The Western Conference on Science Education



ORGANIC CHEMISTRY I AT WLU

- first organic chemistry course
- required for many Year 2 Science students
- prior to 2010 → primarily lecture based
- starting in 2010 → "blended" approach
- course enrollment

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WHY LTIs?

- blended learning: start with learning objectives

Your ability to predict chemical reactivity of organic compounds and illustrate mechanisms by which reactions occur is highly dependent on your ability to *visualize* and *represent* the chemical structures of organic compounds and to *explain* the effect that structure has on reactivity. By the end of this course, you should be able to:
♦ *describe* and *illustrate* the structure of atoms and the nature of bonding between atoms in organic compounds;
♦ *evaluate* the effect that bonding has on the 3-D shape, stability, properties and reactivity of organic compounds;
♦ *assess* the consequences of 3-D shape, conformational mobility and stereochemistry on structure and reactivity of organic compounds;
♦ *provide* the chemical structures of reactants, reagents or products required for or predicted by a given chemical reaction;
♦ *solve* and/or *depict*, using the curved arrow formalism (a.k.a. arrow pushing), the mechanisms by which organic reactions occur

- "What do we have to know…?"
- develop self-monitoring, metacognitive skills

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TYPICAL LEARNING TASK INVENTORY

Learning Tasks for Chapter 6. An Overview of Organic Reactions

After covering the material from this chapter, you should be able to:
♦ *name*, *describe* and *recognize* examples of the four common types of organic reactions
♦ *distinguish* between symmetrical bond breaking/making (radical) mechanisms and unsymmetrical bond breaking/making (polar) mechanisms, and *illustrate* how each type occurs using curved arrows
♦ *name*, *describe* and *illustrate*, using curved arrows, the three mechanistic steps involved in the radical halogenation of alkanes
♦ *define* nucleophile and electrophile, *identify* molecules, and atoms within molecules, that are capable of acting as either or both, and use curved arrows to *show* the movement of electron density when nucleophiles and electrophiles react (IMPORTANT AND ON-GOING TASKS IN THIS COURSE FROM THIS POINT ON)
♦ *define* ΔG° and $\Delta G^\ddagger$ for a given reaction, or for a particular mechanistic step in a reaction, and *sketch* an energy diagram given information regarding the sign and magnitude of ΔG° and $\Delta G^\ddagger$
♦ *describe* the relationship between ΔG° and K_{eq}, and between $\Delta G^\ddagger$ and the rate of a particular step in a reaction
♦ *define* exergonic and endergonic, and, given an energy diagram, *classify* a reaction, or an individual mechanistic step of a reaction, as exergonic or endergonic
♦ given an energy diagram, *locate* starting materials, transition states, intermediates and products, and *identify* the rate-limiting step
♦ for the acid-catalyzed addition of water to ethylene, *draw* a detailed arrow-pushing mechanism and an energy diagram labeled with the rate-limiting step and the locations and structures of transition states and intermediates
♦ *state* the differences between common laboratory reactions and biological reactions

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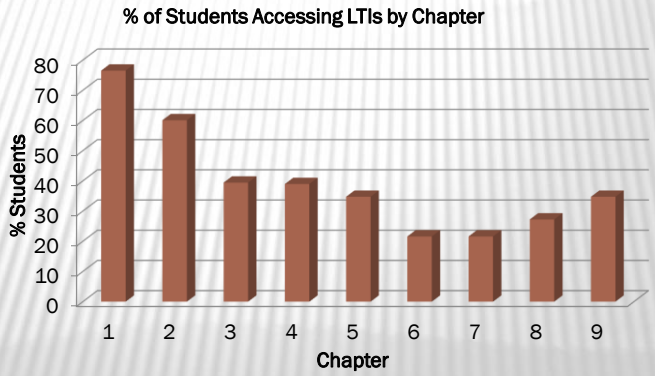
IMPLEMENTATION OF LTIS

2010

- released as pdfs through CMS



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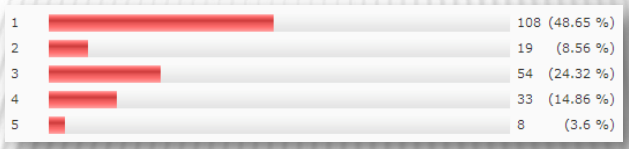
IMPLEMENTATION OF LTIS

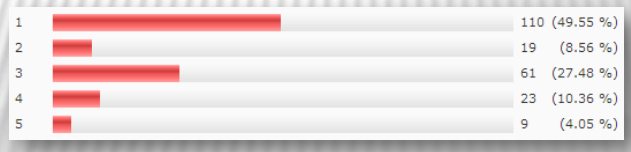
2011

- converted to required surveys in CMS

"State Dr. MacNeil's middle name and date of birth."



"Select 1 if you are reading this question."



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LTI RESEARCH DESIGN

2012

- 293 students (94%) in 'Orgo 1' recruited
- randomly divided into 5 treatment groups
- completed introductory and end-of-term surveys and 9 weekly LTIs

Condition	1	2	3	4	5
LTI	√	√	√	√	√
Prompt	X	√	√	√	√
Quiz	X	X	√ (no feedback)	√ (part. feedback)	√ (full feedback)
Survey	X	X	√	√	√

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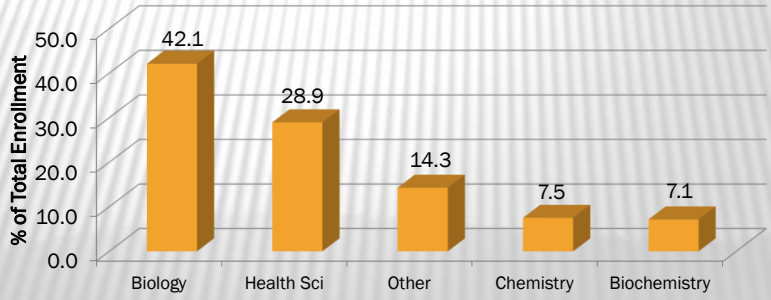
PARTICIPANTS

- 293 participants
- 186 females (69%); 82 males (31%)
- 233 2nd year (86%); 37 3rd, 4th year (14%)
- course required (87%); course optional (13%)



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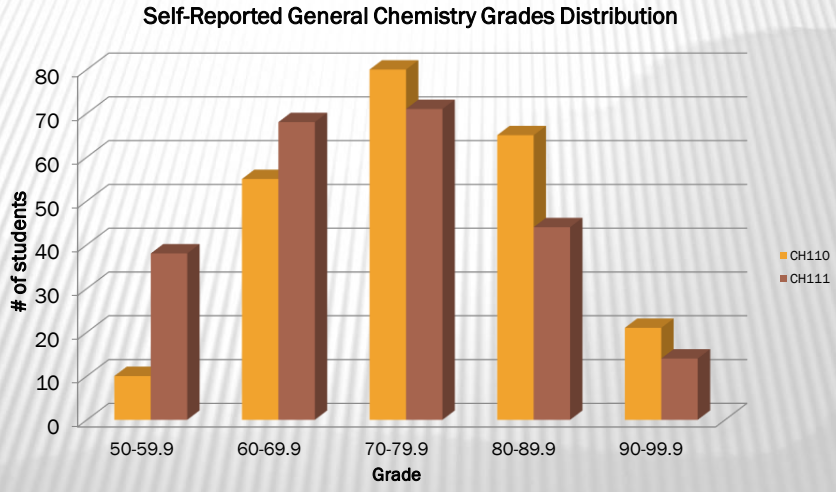
PARTICIPANTS



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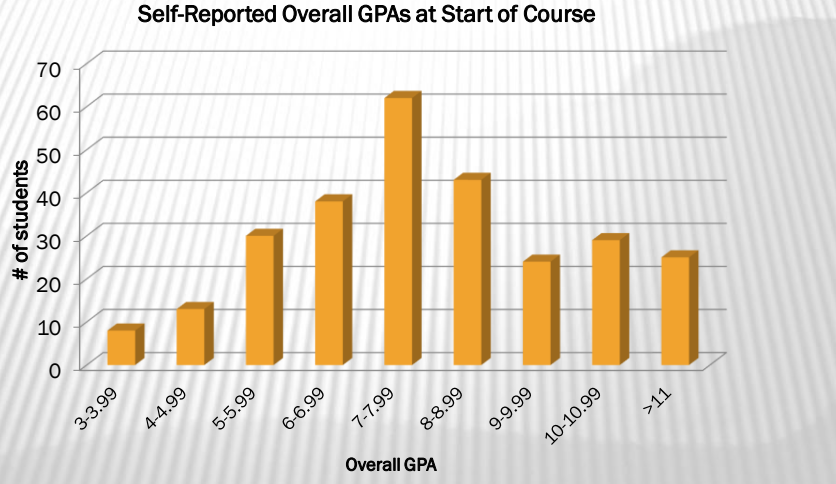
PARTICIPANTS



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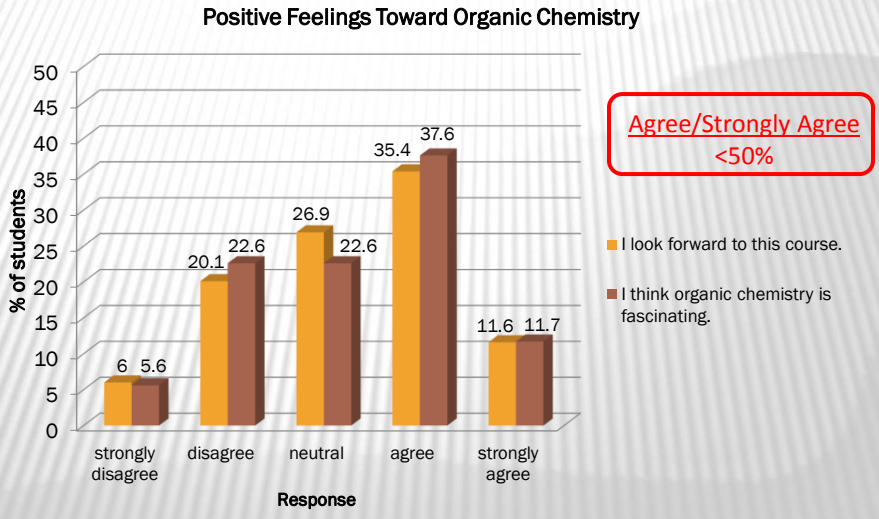
ATTITUDES AND EXPECTATIONS



Agree/Strongly Agree <50%

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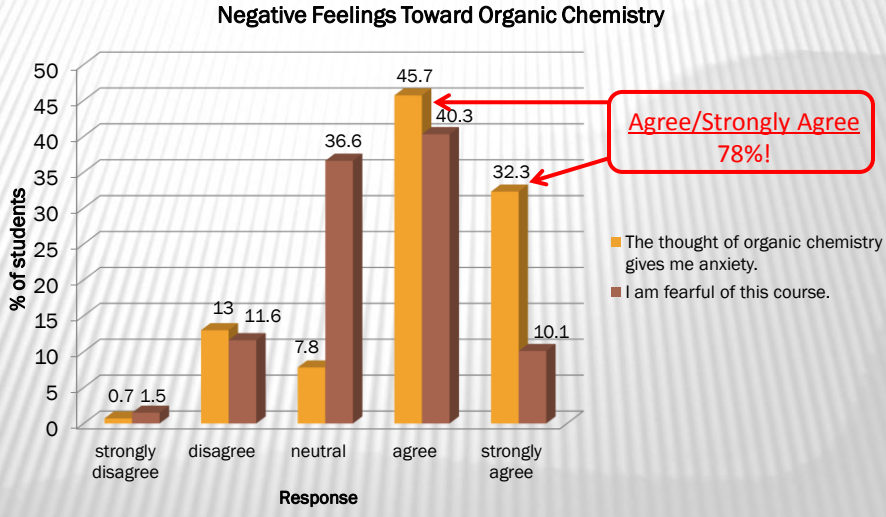
ATTITUDES AND EXPECTATIONS



Agree/Strongly Agree 78%!

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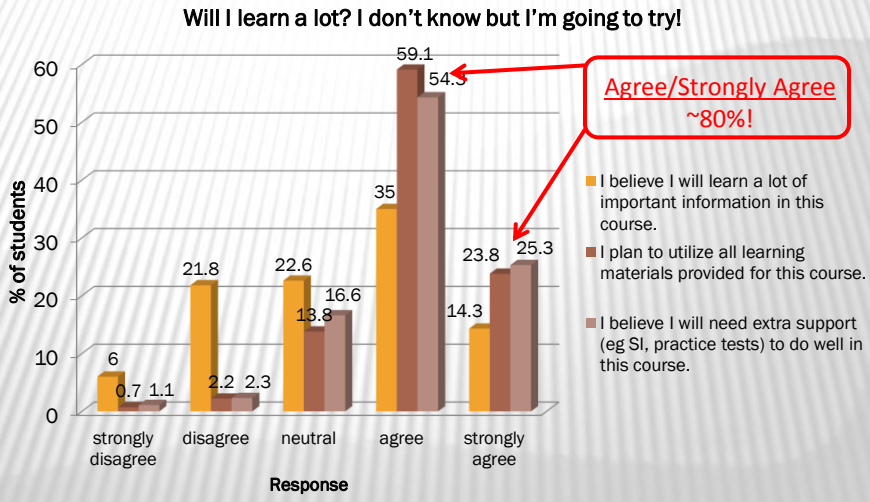
ATTITUDES AND EXPECTATIONS



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RESULTS

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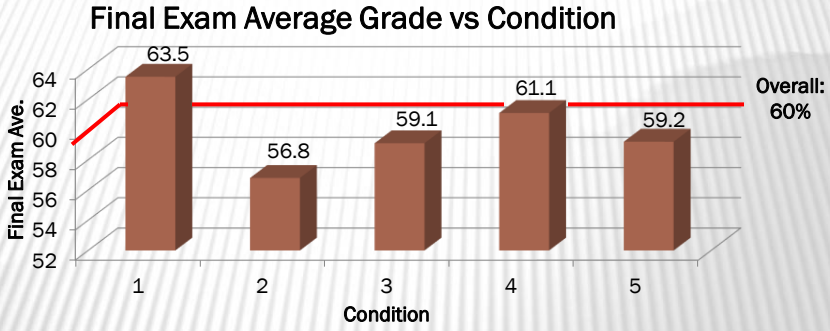
EFFECT OF LTIs



- ANOVA: differences not significant
- ANCOVA: # of LTIs completed is significant

The more LTIs a student completes, the higher the student's final exam grade.

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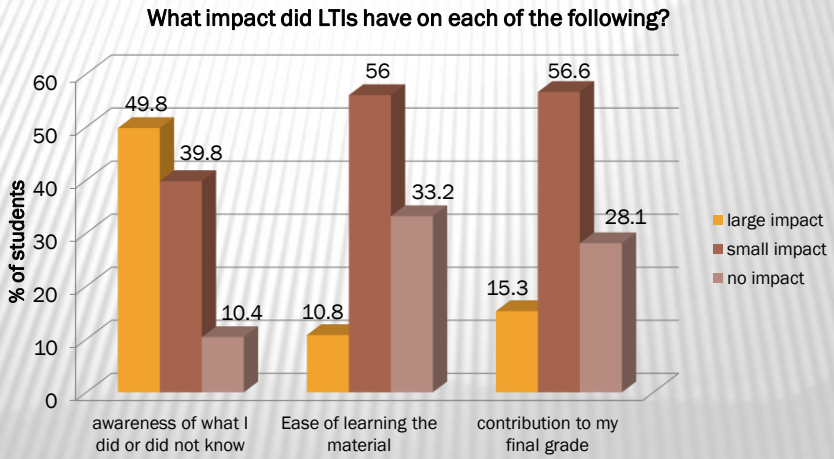
FEEDBACK FROM STUDENTS

- *perceived* effect of LTIs



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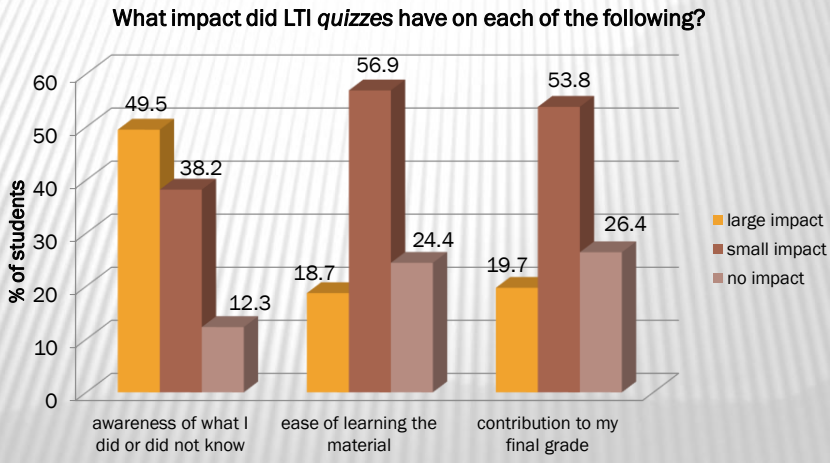
FEEDBACK FROM STUDENTS

- *perceived* effect of LTI *quizzes*



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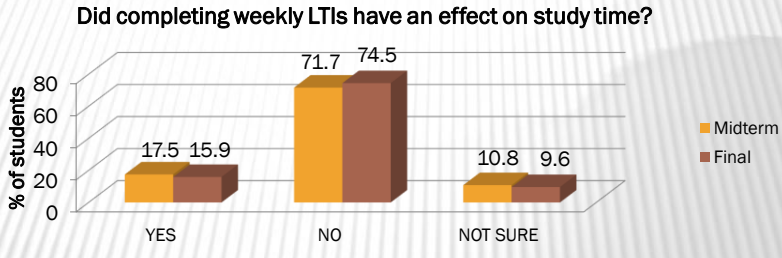
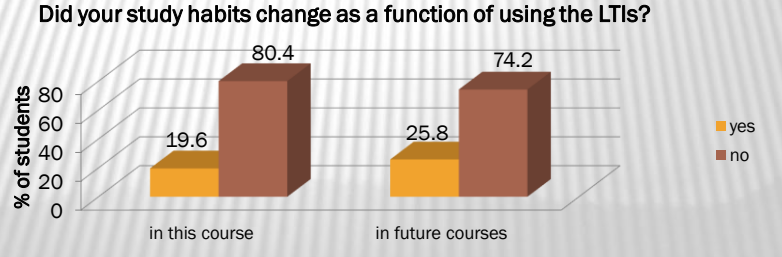
FEEDBACK FROM STUDENTS





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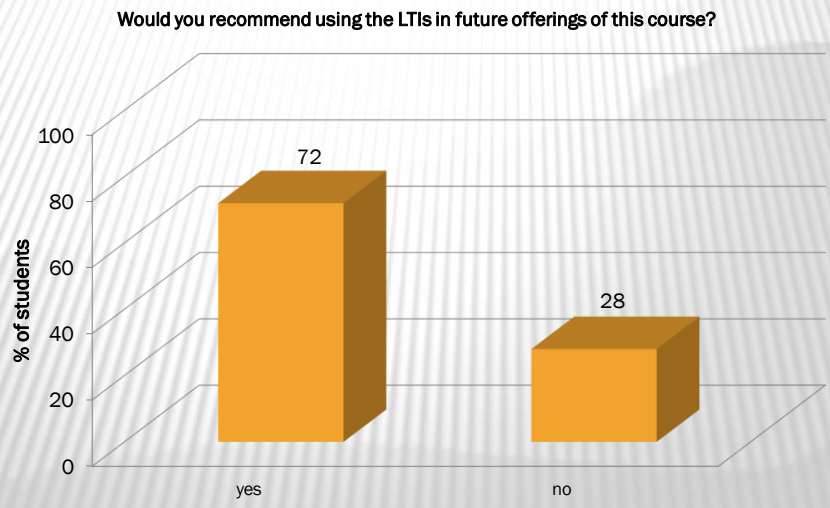
FEEDBACK FROM STUDENTS



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FEEDBACK FROM STUDENTS

- open-ended responses

"HELPED ME FOCUS"

"MORE FEEDBACK"

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CONCLUSIONS

- LTI conditions did *not* have a significant effect on final exam grades
- # of LTIs completed was a significant predictor of final exam grades even after controlling for prior learning
- students feel that LTIs improve "awareness" or "focus" but do not think this translates to improved study habits or grades

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FUTURE WORK

- directly measure metacognitive skills at beginning and end of course
- explore effect of LTI frequency on improvement of metacognitive skills
- hold interviews to gain insight into how students are using the LTIs
- develop scaffolding that supports other aspects of self-regulated learning

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ACKNOWLEDGEMENTS

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