INTRODUCTION

- Student achievement of learning goals in a 1st year extraction experiment
- Questions underwent expert and student validation to improve effectiveness and clarity
- Questions pertained to liquid-liquid extraction and melting point analysis
- Pre-quiz 2-5 weeks prior and post-quiz 2 weeks after experiment
- Normalized learning changes calculated from matched pre-/post-quiz scores

METHODOLOGY

- Maintain consensus, confirm correct answers
- Input analyzed and presented to Research Team
- Questions revised and/or developed from prioritized learning goals and expert validation
- Split between two versions of quiz

- “Think-aloud” interviews improved clarity, functionality and interpretation of questions
- All students wrote same version of pre/post quiz
- Comparison groups: (1) only post-quiz given to assess “pre-test effect”, (2) pre-/post-quiz written before lab to determine if changes due to actual lab
- Examination of Learning goals that could not be assessed in written format (86% reliability)

- Processing and scoring of quizzes, exclusion of invalid data, single factor ANOVA, (paired) t-test, repeated measures Cohen’s d, normalized learning change
- Alignment of technical skill expectations between upper-level Chemistry laboratory courses

Participant Demographics and Responses:

Students (1600 total)

- 1st year: 96% Female, 42% Male
- Canadian Citizen: 82% English as a 1st Language: 48%

Group 1

- 96% Male, 39% Female
- 83% English as a 1st Language

Group 2

- 94% Male, 44% Female
- 81% English as a 1st Language

DOUBLE ENDED FIGURE

<table>
<thead>
<tr>
<th>Version</th>
<th>Average Quiz Scores for Version 1</th>
<th>Average Quiz Scores for Version 2</th>
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Comparison group (1)

- ANOVA found no significant difference (p > 0.05) in pre-/quiz versus those that also did the pre-test, 74.09 ± 2.05% for Version 1, 72.85 ± 1.97% for Version 2
- Prior exposure to questions did not influence post-test scores, so existence of “pre-test effect” not supported

Comparison group (2)

- Paired t-tests found no significant difference (p > 0.05) in pre-/post-tests scores before completing the experiment, 0.006 ± 0.039 for Version 1 and 0.045 ± 0.035 for Version 2
- Calculated normalized learning changes are attributed to student performance on the Experiment

RESULTS

- Which of the following are generally true of the layer positions in a liquid-liquid extraction?
  - T F The water layer is the top layer.
  - T F The organic liquid is the bottom layer.
  - T F The liquid that contains more dissolved solids will be the bottom layer.

  Incorrect responses likely from in-lab experience
  - Student realization of density and layer positioning noted (Q12, Vers. 2)

CONCLUSIONS

- Third round of question refinement, better optimized to target learning goals of the experiment
- Learning changes were noted in all sections, 41% and 35% of total possible learning on average
- Comparison groups showed no “pre-test effect” evidence and that learning attributed to experimental lab work

FUTURE WORK

- Reduce the amount of excluded pre-test data
- Compare results of each question by year
- Cross-reference responses to determine individual learning gains (or losses) by topic
- More in-depth analysis of student demographics needed

REFERENCES


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