



# *Web-Based Puzzles for Chemistry*

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# *Our approach*

- There may never be proof that computerized instruction is better than traditional instruction.
- However,
- Online learning IS a reality.
- How can we improve it?

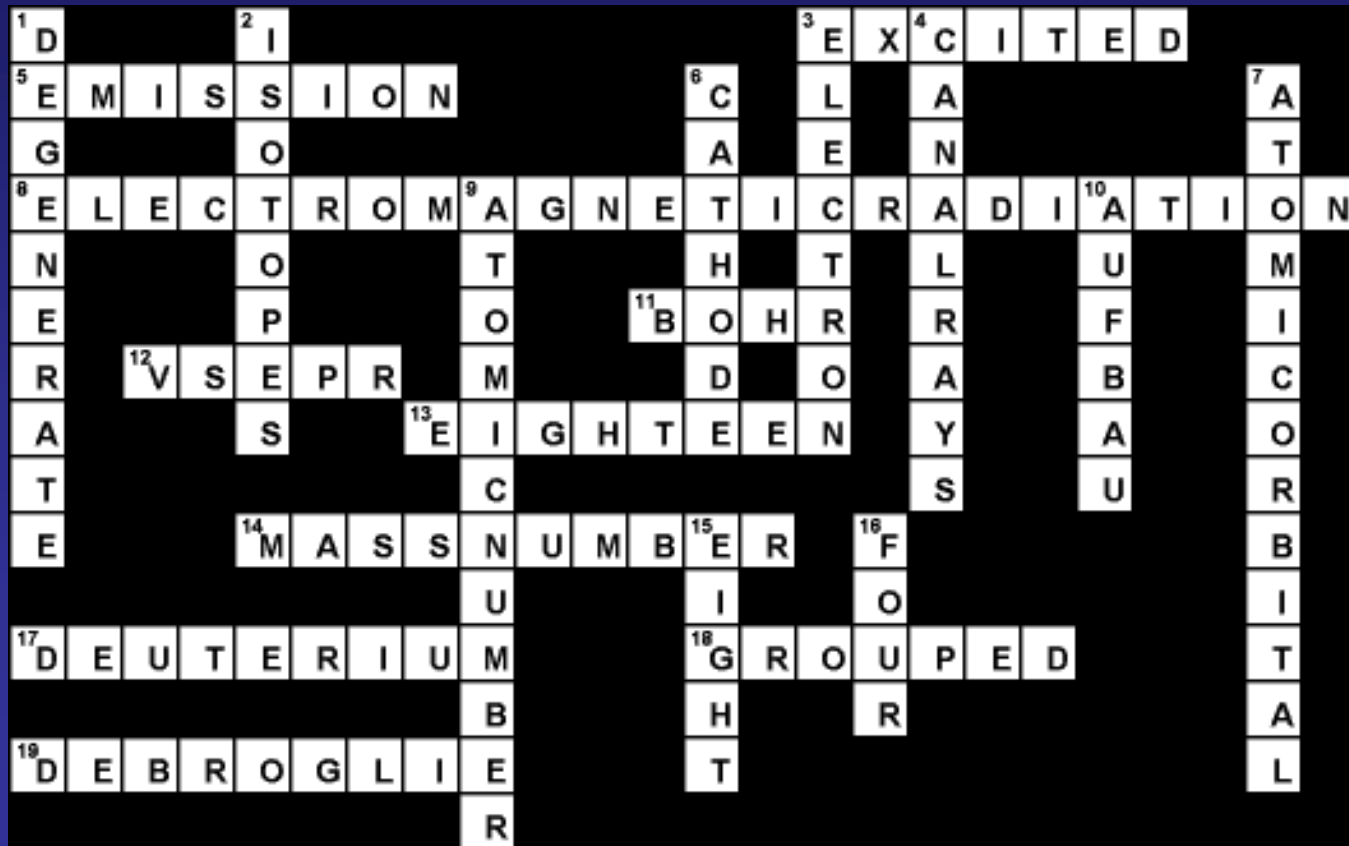


# *What we've created*

- Online chemistry crossword puzzles
- An online periodic table puzzle
- An online, puzzle-based 'virtual-lab' experiment

# Crossword puzzles

- Example





# *Crossword puzzles*

- Purpose = vocabulary mastery
- Role = preparatory activity



# *Crossword puzzles*

“Recent developments in science curricula have often tended to adjust the balance between process and content, between knowledge and practical skills. Chemistry is an inherently practical subject, yet it is important that students build up a sound foundation of factual knowledge.”

-S. Cotton (1998)



# *Crossword puzzles*

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# *Crossword puzzles*

- Benefits
  - Interactivity / Active learning
  - Immediate grading & feedback
  - Motivation



# *Crossword puzzles*

“Often a source of frustrations for teachers of chemistry and a perceived nuisance for their students is the study of chemical nomenclature. ...any other mechanism that would provide students with more nomenclature practice, especially in a way that would remove some of the tedium of the task by making it more of a game, would seem to be useful.”

-Mullin & Courtney (1996)



# *Crossword puzzles*

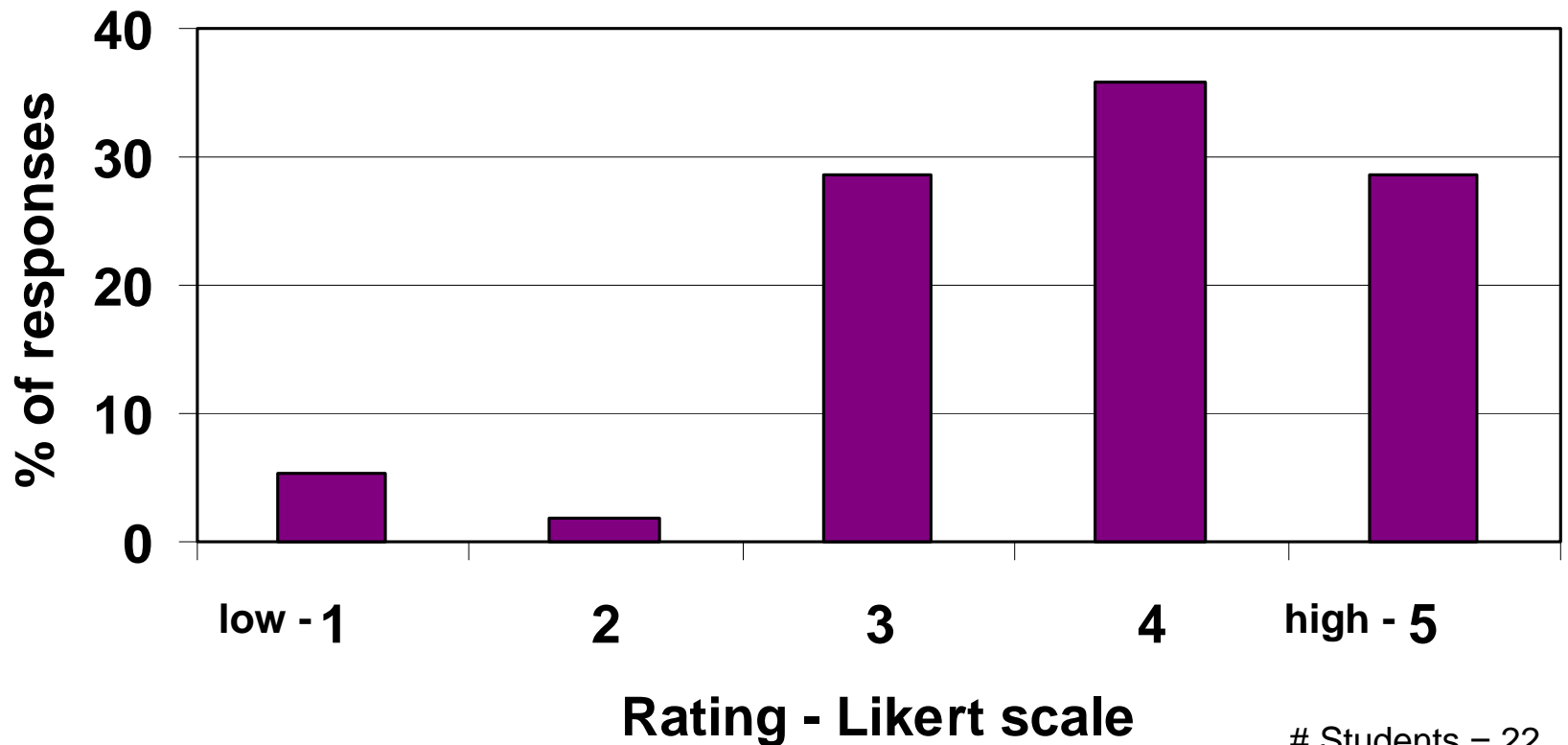
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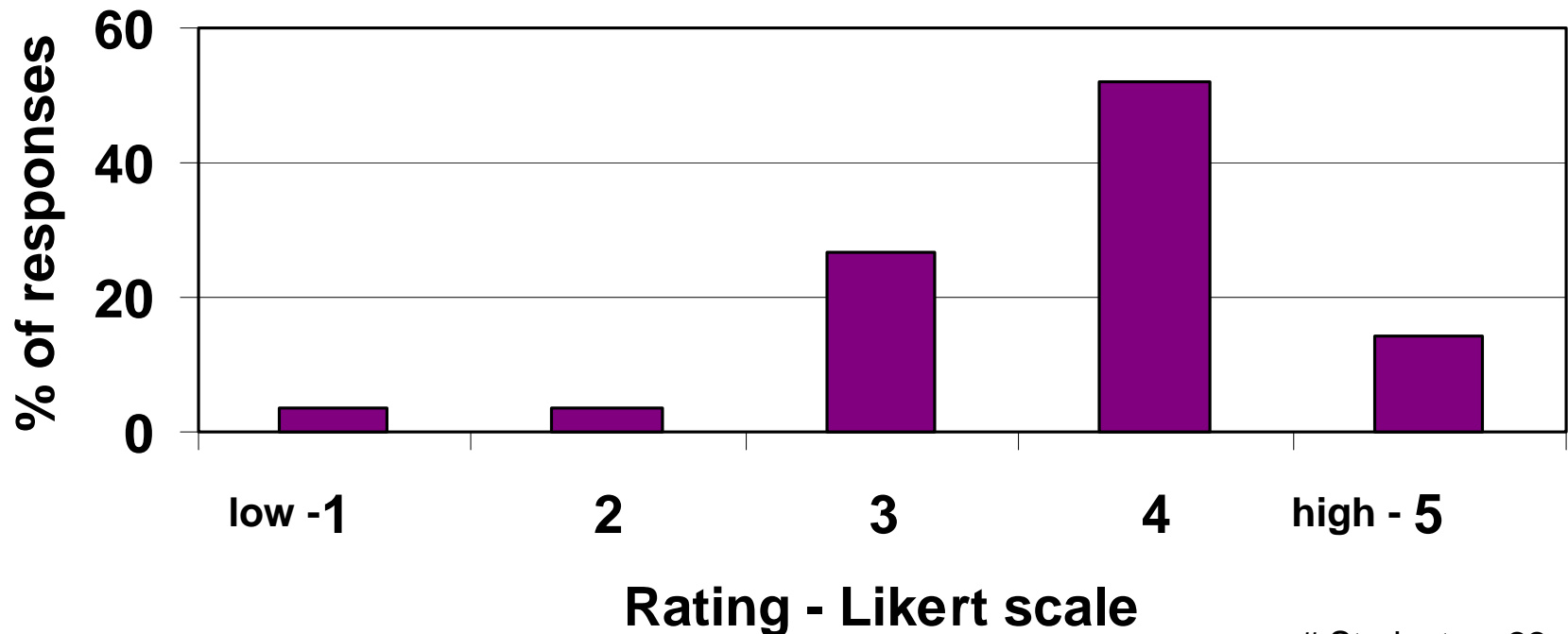
# Results – Crossword puzzles

Rate your enjoyment in completing this puzzle



# Results – Crossword puzzles

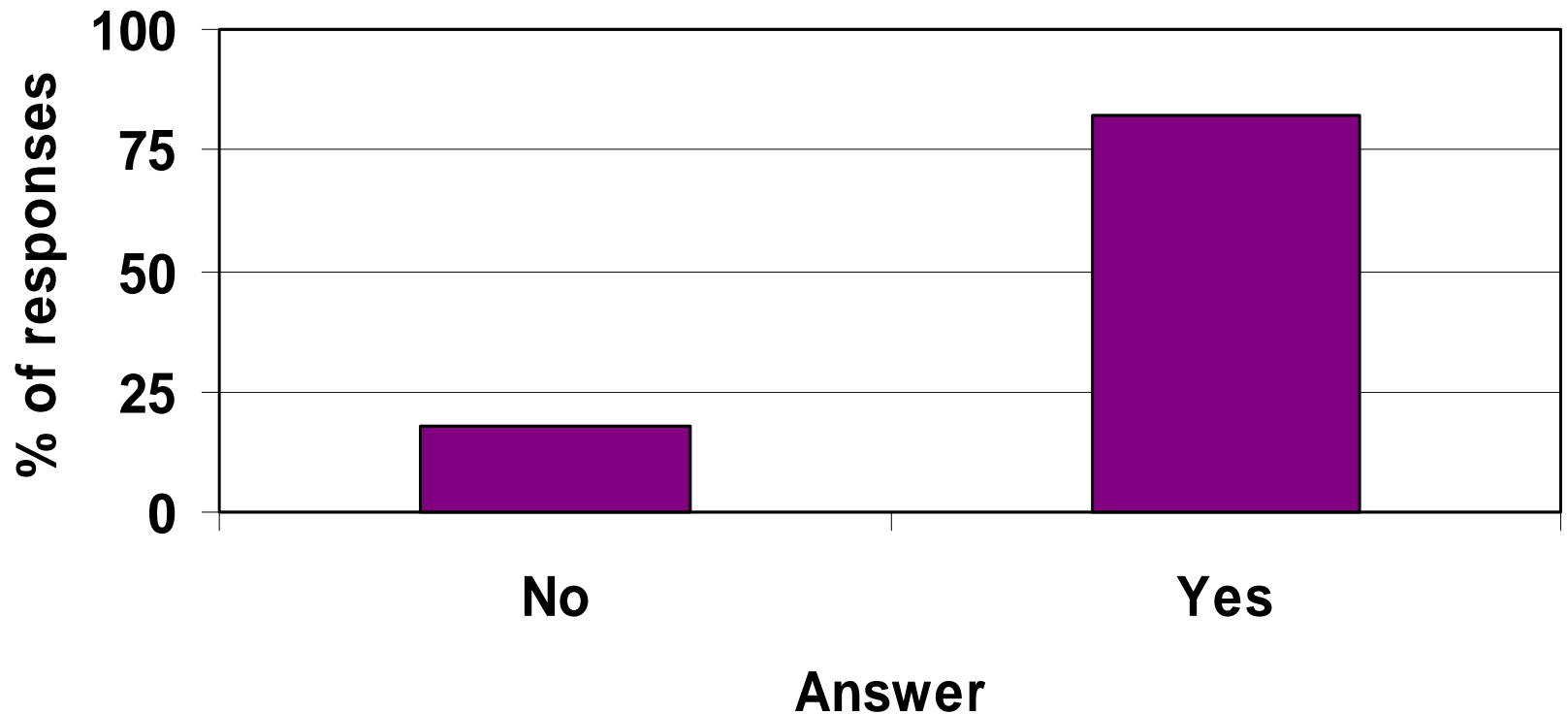
Rate how well the puzzle helped your understanding of key terms



# Students = 22

# Results – Crossword puzzles

Do you feel more prepared for lectures?



# Students = 22



# ***Results – Crossword puzzles***

- “very good icebreaker before observing lectures”
- “I like doing the crossword puzzles. they were a way to get me to reread the book.”
- “Original and effective concept for introducing new material to students.”



# *Results – Crossword puzzles*

- “I honestly think it was a more enjoyable way to incorporate the text and make it easier to understand.”
- “yes this is fun!”
- “the puzzles are very helpful because they make you put the info all together in the chapter”



# *Results – Crossword puzzles*

- “stop with the surveys”
- “This crossword was a little more challenging, but beneficial [sic].”
- “I looked for answer to 20 across for an hour and could not find it! Argh!”

# *Logic Puzzles*

- Examples

- Periodic table puzzle



- Ten solutions puzzle





# *Logic Puzzles*

- Purpose = conceptual understanding
- Role = follow-up activity



# *Logic Puzzles*

- Benefits
  - Immediate grading and feedback
  - Interactivity / Active learning
  - Motivation
  - Collaboration



# ***Results – Periodic table puzzle***

- Neutral responses to survey questions



# ***Results – Periodic table puzzle***

Pretest avg. = 81.9%,

st.dev. = 15.2

Posttest avg. = 84.8%,

st.dev. = 13.4

#students = 19

**NOT** Statistically Significant

Puzzle score avg. = 52%



## ***Results – Periodic table puzzle***

- “This was very confusing to me and pretty difficult. i dont [sic] really think it helped me prepare for the test.”
- “I hated this puzzle!”
- “this was an okay excersise [sic] for the test”



# ***Results – Ten solutions puzzle***

- Coming Soon...



# *Possible Implications*

- Determine what are effective components of a web-based course.
- Provide practical information to others developing online courses or attempting to use computers to teach chemistry.



# *Summary*

- Crossword puzzles were a success
- Periodic table puzzle needs work
- Ten solutions puzzle data coming



# *Acknowledgements*

- University of Texas Telecampus
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***Thank You***

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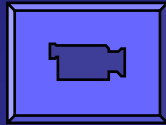


# References

- Cotton, Simon (1998). Extended Wordsearches in Chemistry. Journal of Chemical Education. v75 n4, p.489-90
- Mullin, J. & Courtney, P. (1996). Using Inexpensive “Find & Circle” Word Search Software in the Study of Chemical Nomenclature. Journal of Chemical Education. v73 n6, pA130

# Chem1

Example of lecture material



# Example Pre/Post test questions

## – Periodic table puzzle

1. Which of the following elements has the smallest radius?  
a) Na    b) Mg    c) Al    d) Si    e) P
2. What would be the outer electron configuration of halogens?  
a)  $ns^2 np^6$     b)  $ns^2 np^5$     c)  $ns^2 np^7$   
d)  $ns^2 np^4$     e)  $ns^2 nd^5 np^0$



# *Example Pre/Post test questions*


## *– Periodic table puzzle*

3. As a general rule, EN increase from \_\_\_\_\_  
in the periodic table.
- a) Left to right and top to bottom
  - b) Left to right and bottom to top
  - c) Right to left and top to bottom
  - d) Right to left and bottom to top
  - e) Left to right only

# *Pre/Post test example questions*

## *– Ten solutions puzzle*


1. AgOH is insoluble. AgNO<sub>3</sub>, NaOH, and NaNO<sub>3</sub> are soluble. Which species cannot be present after AgNO<sub>3</sub>(aq) and NaOH(aq) are mixed?
  - (a) AgOH (aq)
  - (b) NaNO<sub>3</sub> (aq)
  - (c) AgOH(s)
  - (d) All are present
  - (e) None is present



# *Pre/Post test example questions*

## *– Ten solutions puzzle*

2. Will a precipitate form when 0.1 M aqueous solution of  $\text{CaCl}_2$  and  $\text{K}_2\text{CO}_3$  are mixed? If a precipitate does form, identify the precipitate for the reaction.
- (a) no precipitate forms
  - (b)  $\text{CaC}_2$  precipitates
  - (c)  $\text{KCl}$  precipitates
  - (d)  $\text{CaO}$  precipitates
  - (e)  $\text{CaCO}_3$  precipitates



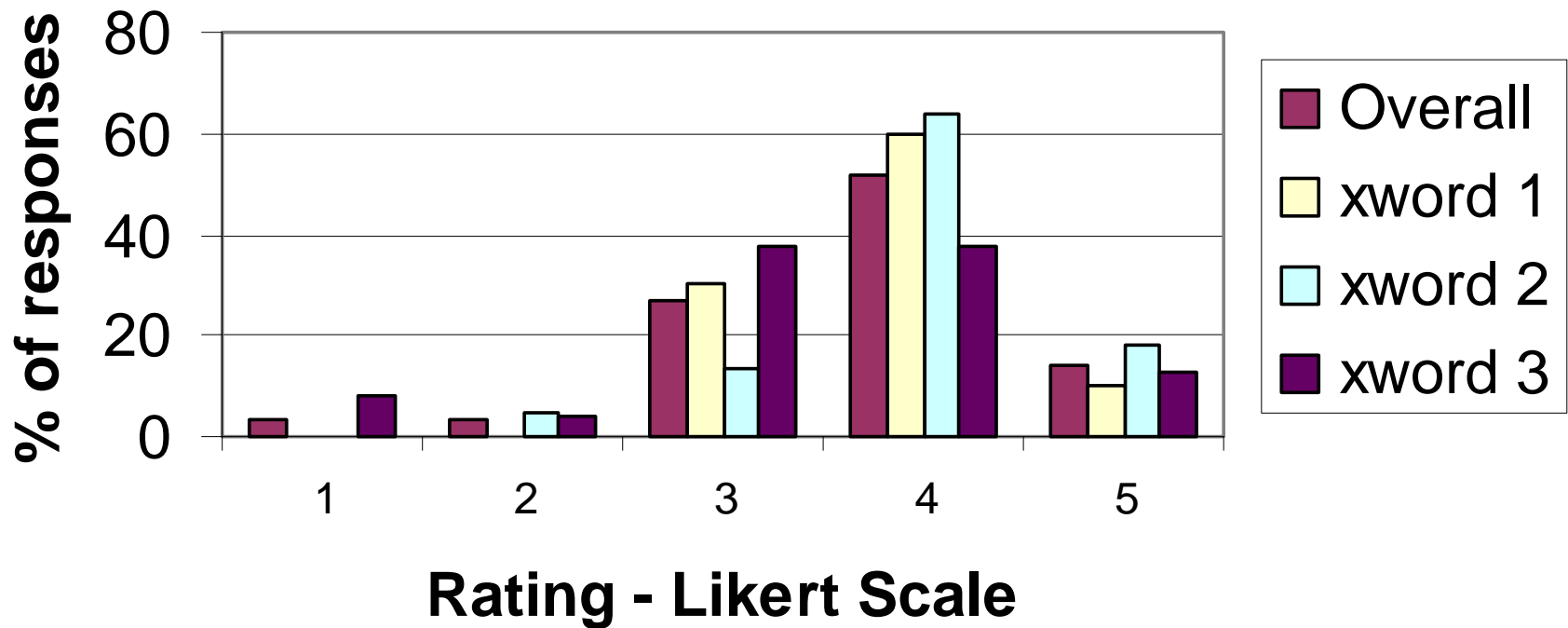
# *Pre/Post test example questions*

## *– Ten solutions puzzle*

3. AX and BY are binary, ionic species where A and B are cations, and X and Y are anions. When aqueous solutions AX and BY are mixed, a yellow precipitate forms. From this information, we know that...
- a) Either A, X, B, or Y is a yellow solid in solution
  - b) Either AX or BY is insoluble
  - c) The compound AXBY is a yellow solid
  - d) Either AY or BX is insoluble
  - e)  $AX(aq) \rightarrow AX(s)$  in the presence of BY or vice versa

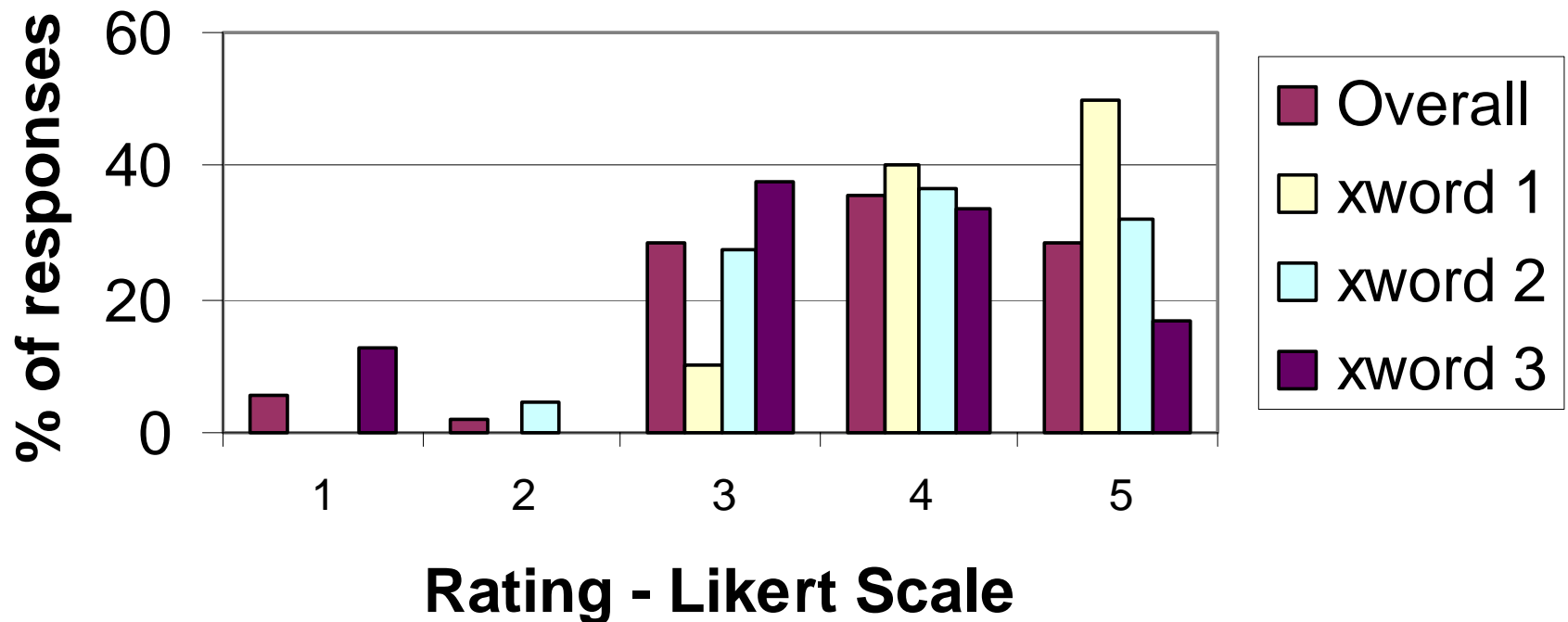
# Results - Crossword

## Understanding of Key Terms

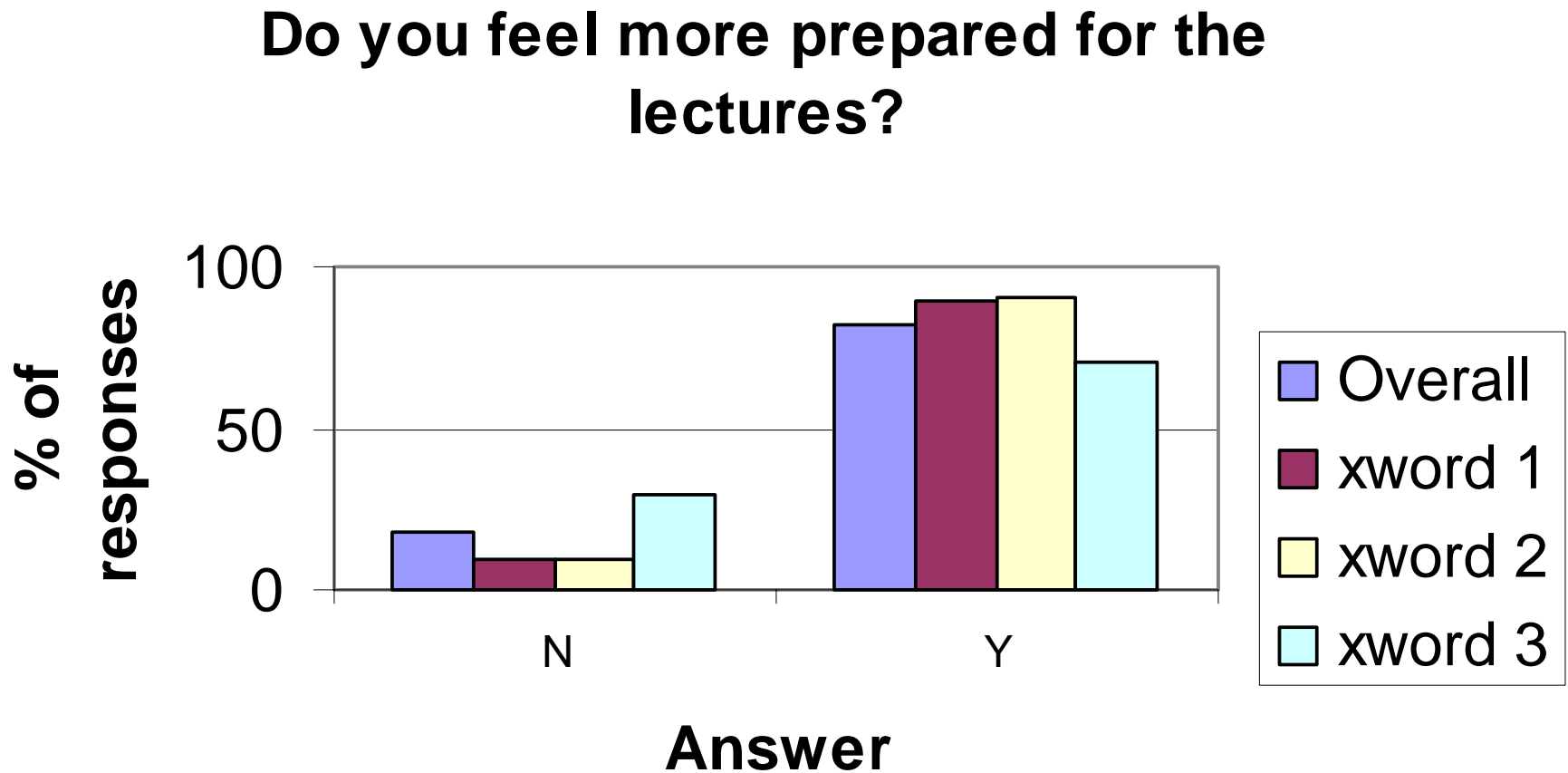


# Results - Crossword

## Enjoyment



# Results - Crossword





# *Future work*

- Improve periodic table puzzle and retest
- Conduct controlled experiments with two sections of 25 students
- Conduct controlled experiments on larger test groups