An Investigation of Secondary Students' Interests in Nanoscience

Nano-SLAM Group
(Student Learning and Motivation)

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INTRODUCTION

- Student learning in science can increase when:
  - Students are taught topics that are interesting to them[1]
  - Students are taught topics that are relevant to their lives[1]
  - The information is given in a meaningful context[1]
  - The use of hands-on activities is frequent[2]
  - Innovative teaching practices such as inquiry or project-based learning are implemented effectively[3,4]
- Little research has been done to determine topics that are of interest to students[1]

RESEARCH QUESTIONS

- What are student interests in relation to a set of defined nanoscience concepts?
  - How do these interests compare between grades?
  - How do these interests compare between genders?
  - How do these interests compare between schools?
- What nanoscience concepts do students find the most and least interesting? Why?

METHODS

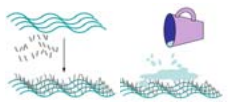
- Experiments/Activities
  - Introduce nanoscience phenomena to students in the classroom allowing students to interact with the materials
    - Real-world objects/systems from a variety of contexts used to make key ideas plausible[5]
- 3-Point Likert-Type Questionnaire
  - Assess students' interest in various driving questions and nanoscience phenomena
    - Well-designed question employed in problem-based science which is analyzed, investigated, and answered by students and the teacher[6]
  - 1: not interested; 3: very interested
- Individual Structured Interview
  - Probe students' interest in various driving questions and nanoscience phenomena

PARTICIPANTS

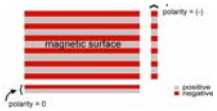
- 260 students surveyed
  - 7th grade students
    - Indiana Rural Middle School (RMS), (n=74)
    - Indiana Suburban Middle School (SMS), (n=55)
  - Chemistry students (10th-12th grade)
    - Indiana Rural High School (RHS), (n=90)
    - Indiana Suburban High School (SHS), (n=41)
- 23 students interviewed
  - 5 to 6 from each classroom
    - 3 male, 3 female
    - Low, mid, high achieving students

EXPERIMENTS/ACTIVITIES

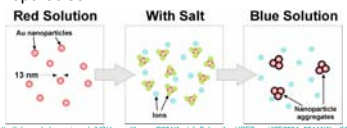
- Stain-Free Pants



- Hopping Magnet

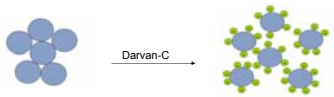


- Gold Nanoparticles



http://chemed.chem.wisc.edu/HSJournal/Issues/2004/Apr/clickSubscriber/JCESupp/JCE2004p0544AW.pdf10

- Easy-Stir



Likert-Type Questionnaire

- How do we know atoms exist?
- If a penny is made of tiny particles (atoms) why doesn't it fall apart?
- What do a pencil, diamond ring, car tire, and charcoal have in common?
- How can a gecko walk upside-down on the ceiling?
- When will gold no longer be the color gold?
- How did aspirin stop my headache today and my fever last week?

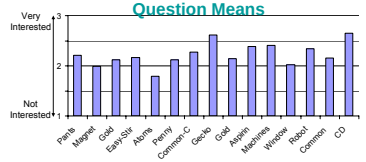
- What kinds of machines are small enough to fit inside a living cell?
- What can be done to keep a window clean, making sure water and dirt do not stick?
- How can we make DNA act like a robot?
- What do Styrofoam, fog, milk, jell-o, latex paint, and steel have in common?
- Why does a CD have so many colors on the back? Do those colors have anything to do with the music stored on it?

DATA ANALYSIS

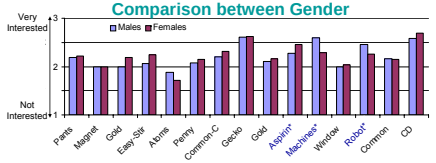
- Quantitative
  - Determine mean value for each activity and driving question
  - Determine statistical significance (α=0.05)
    - Grades (middle vs. high school)
    - Gender
    - School context (rural vs. suburban)
- Qualitative
  - Transcripts analyzed using a phenomenographical framework
    - "…the limited number of qualitatively different ways in which we experience, conceptualize, understand, perceive, apprehend, etc, various phenomena in and aspects of the world around us"[7]

PRELIMINARY RESULTS

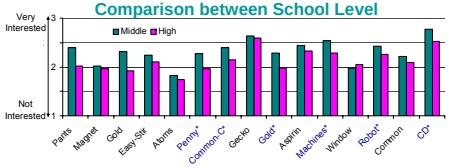
Question Means



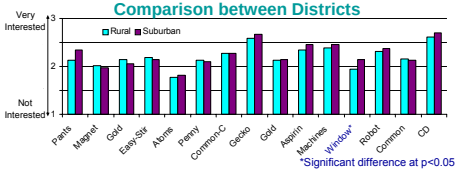
Comparison between Gender



Comparison between School Level



Comparison between Districts



*Significant difference at p<0.05

Influences on Students' Interests

- Relation to Everyday Life Experiences
  - "The more they relate to our everyday lives, the more we're gonna be willing to pay attention and learn about them cause we can interact with it more than just going to class, sitting in class, and doing the homework, like we can put it to our lives." –SHS,M/LM
- Hands-On
  - "I like hands-on stuff, so maybe if we did a little more like got deeper into the subjects and you know tested out what the different components or whatever, that might be fun." –SHS,L/MM
- Use of Chemicals
  - "I'm interested in all the ones that we had to mix different chemicals together because I like to see what happens in the end. And the other ones I was not very interested in because I didn't get to use different chemical stuff." –SHS, HF
- Current Interests
  - "I'm more interested in like aeronautical stuff…the more practical side of Chemistry." –SHS,L/MM
- Prior Knowledge
  - "It wasn't really interesting cause I've already learned about it." –SHS, LF
  - "I've actually never seen or heard about stuff that could do that and I just thought it was kind of cool." –RMS, AB
- Prior Experience
  - "All I saw was a color change and there's a lot of different experiments that, you know, have a different color change" -SHS,HM

CONCLUSIONS

- Students are interested more in questions that
  - are odd/novel
    - How can a gecko walk upside-down on a ceiling?
  - can be experienced
    - Why does a CD have so many colors on the back?
- Students are least interested in questions that
  - are abstract
    - How do we know atoms exist?
- The amount of prior knowledge and prior experience inversely affects student interest
- Middle school students were more interested in all questions compared to high school students as expected; however from these results show potential motivators for high school students
  - Gecko
  - CD
- Very few questions have a significant difference between gender indicating that these driving questions will be of interest to both males and females
- Introducing nanoscience into the classroom may be of benefit to student learning in topics currently introduced in 7-12 classrooms as it will increase interest
  - Novel
  - Certain nanoscience aspects can be experienced
  - Little prior knowledge and experience

FUTURE WORK

- Continue analysis of data
  - Quantitative statistics
  - Coding transcripts of remaining schools
  - More detail of how hands-on activities and real-life issues affect student interests based on interviews
- Professional development
  - Analyze programs conducted at UTEP and Purdue Summer 2006
  - Activities on size and scale, particulate nature of matter, forces, allotropes of carbon, self-assembly, scanning probe microscopy
- Critique and revise activities created during professional development programs (PU) and summer camp (UM)
- Create new nanoscience activities
- Introduce activities into secondary school classrooms to determine students' responses

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