Applying Knowledge in New Contexts: A Comparison of Pre- and Post-Instruction Students

Dyan L. McBride[1] and Dean A. Zollman

Kansas State University, Manhattan KS, 66502

[1]Present Address: Mercyhurst College, Erie PA, 16506

Description of Study

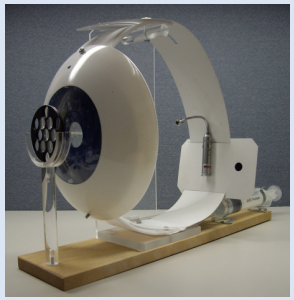
- Knowledge construction in a new context
  - Wavefront aberrometry
- Examine the types of resources students use
- Two participant groups
  - Pre-instruction students: enrolled in first-semester of introductory-level algebra-based
    - No formal light/optics instruction
  - Post-instruction students: enrolled in the second semester of introductory-level algebra-based
    - Covered light, mirrors, lenses, optics of near- and farsightedness
    - Recitations, textbook homework problems, and an exam

Research Question

What are the differences, if any, in the resources used by students who are pre- instruction in optics and those who are post-instruction in optics and in the ways in which the two groups use prior knowledge when constructing an understanding of the new context?

Methodology

- Learning/ Teaching Interviews[1]
  - Algebra-based Physics Course
    - Pre-Instruction in light/optics
    - Post-Instruction in light/optics
- Phenomenographic Approach[2]
- Resource Analysis[3]
  - Construction of knowledge in new context



Basic Knowledge about Vision

- Similar conceptions about vision and the human eye
  - Eye is single-lens system, lens and screen (retina)
- Vision defects: less than half could explain
  - Result from a defect in the lens, not shape of eye

Activated Resources

- The shape of a lens affects the image focus
- Lenses divide up the light
- Light entering a lens differently will focus differently
- The distance light travels determines the angle
- Use of physics equations

Knowledge Construction Approach

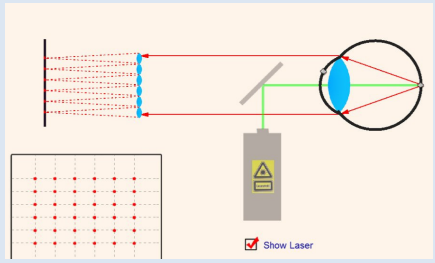
- Willingness to discuss aberrometry varied
  - Pre-instruction: willing to answer questions about eye, hesitant and reserved with aberrometer
    - Epistemic state may be 'knowledge is viewed as stuff that is propagated from authority'[4]
  - Post-instruction: more willing to discuss, predict, explain, etc
    - Epistemic state may be 'knowledge is constructed' or 'knowledge is freely created'[4]

Necessary Scaffolding

- Pre-instruction students
  - Required scaffolding in every aspect
    - Exploration of converging/diverging lenses
    - Manipulation of models of the human eye
  - Had to be encouraged to apply new information
- Post-instruction students
  - Approached activities as verifications of their prior knowledge
    - Readily applied their knowledge
    - Scaffolding was of much larger step-size than was required for the pre-instruction students
      - Drawing of light rays through a lens in order for them to think about what happened to the focal point

Conclusions

- Students have a wide range of knowledge about the human eye, its functions, and vision defects
  - Students also have a significant body of resources that they used
- Pre-instruction students felt unprepared to construct an understanding of wavefront aberrometry but were able to do so with scaffolding
  - The students' hesitance with the material suggests that they did not realize that understanding wavefront aberrometry was within their range of capability – their Zone of Proximal Development (ZPD)[5]
- Wavefront aberrometry was well within the ZPD of students with some basic knowledge of light and optics
  - Able to construct their knowledge more independently and with less scaffolding
- While traditional instruction provided students with the confidence to use their knowledge of optics in this new context, it also hindered their use of equally-productive resources from everyday experiences.



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