Applying Knowledge in New Contexts: A Comparison of Pre- and Post-Instruction Students
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\section*{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

\section*{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?

\section*{Methodology}
- Learning/Teaching Interviews\textsuperscript{1}
  - Algebra-based Physics Course
    - Pre-Instruction in light/optics
    - Post-Instruction in light/optics
- Phenomenographic Approach\textsuperscript{2}
- Resource Analysis\textsuperscript{3}
  - Construction of knowledge in new context

\section*{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

\section*{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

\section*{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 constructed’ or ‘knowledge is freely created’\textsuperscript{4}
  - Post-instruction: more willing to discuss, predict, explain, etc
    - Epistemic state may be ‘knowledge is viewed as stuff that is propagated from authority’\textsuperscript{4}

\section*{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

\section*{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)\textsuperscript{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.

\section*{References}

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