


Using Contemporary Vision Diagnosis for Teaching Physics*

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* Supported by NSF grant DUE 04-27645



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Introduction

- Part of Modern Miracle Medical Machines
 - Introductory physics concepts applied to medical imaging techniques
 - Investigate application of previous knowledge to new contexts
- Wavefront Aberrometry
 - Relatively new method
 - Gaining popularity
 - Used in LASIK procedures

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Physics of Wavefront Aberrometry

- A low-power laser beam is shone into the eye and focused on the retina.
- The light is reflected back through the eye.
 - It passes through the media, lens, and cornea, so it picks up those aberrations.
- Light exits the eye through an array of tiny lenses.




Image from www.zyoptix.com




Image from www.optics.ru

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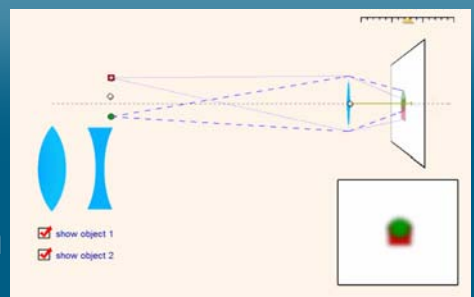
Instructional Materials

(Still being developed)

- Progressive development of eye model
 - Starts with pinhole eye
 - Add single lens
 - Add accommodation ability
 - Then defines the parts of human eye
- Vision defects
- Diagnosis methods

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Computer Simulation

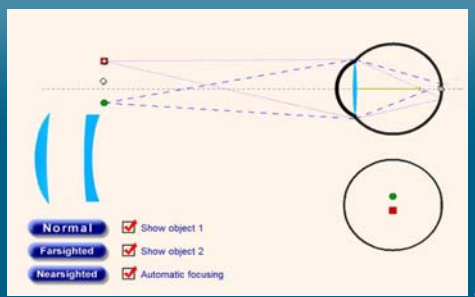


show object 1

show object 2

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Computer Simulation cont'd



Normal Show object 1

Farsighted Show object 2

Nearsighted Automatic focusing

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How do students build an understanding of wavefront aberrometry?

- No expectation of prior knowledge
- Prior experience with optics

- Conduct research to follow how students develop a model of aberrometry


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Methodology

- Semi-structured interviews
 - N=12
 - Calculus-based physics student
 - Pre-instruction in optics
- Questions about human eye, defects, traditional diagnosis
- Modeled aberrometer

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Modeling Aberrometry



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Reasoning Resources Used to Understand Aberrometry

- Light moves as a straight line (9 of 12)
- Light entering a lens differently will focus differently (10 of 12)
- Big change on grid means a big aberration (4 of 12)
- Objectivity of diagnosis is like a classroom test (7 of 12)
 - Same procedure for everyone
 - Errors average out

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Conclusions and Future Work

- Students were very responsive to learning about aberrometry
- Need scaffolding to activate the resources needed to understand aberrometry
- Continue to work toward developing teaching and learning materials

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Acknowledgements:

Hartmut Wiesner and Giuseppe Colicchia
 Lehrstuhl fuer Didaktik der Physik
 Ludwig Maximilian University

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THANK YOU!

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