

# Using computer software to teach optics



**Azita Seyed Fadaei**

*Department of Physics, Shahid Bahonar Teacher Training Center,  
Hafez Street, Tehran, Iran.*

**E-mail:** seiedf@yahoo.com

(Received 2 August 2010; accepted 10 September 2010)

## Abstract

Learning concepts related to specific phenomena becomes easier and more effective when learners are allowed to experiment them with their own senses. Optics, basic phenomena can be perceived by seeing, although sight is also involved through images, text, video and real life experiments and animation. Science classrooms are filled with the voices of teacher and students, it is clear that communication and learning in the classroom are achieved by more than just linguistic tools. Therefore a learning tool which involves the sense of seeing should be welcomed, specially if it is easy to implement. Two cometer software are used for creating the facility to help students try to explore optics phenomena, at the virtual space.

**Keywords:** Optics, Computer Software, Looking Glass.

## Resumen

Aprender conceptos relacionados a fenómenos específicos se vuelve fácil y más efectivo cuando a los educandos se les permite experimentar con sus propios sentidos. Fenómenos ópticos básicos pueden ser percibidos viendo, aunque la vista está también involucrada a través de imágenes, texto, video y experimentos de la vida real y animación. Las clases de ciencia se llenan con las voces de los maestros y estudiantes, es claro que la comunicación y la enseñanza en el salón de clases es alcanzada por algo más que sólo herramientas lingüísticas. Por lo tanto, una herramienta de enseñanza que involucra al sentido de la vista debe de ser bienvenida, especialmente si es fácil de implementar. Dos programas de software para computadora son usados para crear la facilidad de ayudar a los estudiantes a tratar de explorar fenómenos ópticos en el espacio virtual.

**Palabras clave:** Óptica, Software Computacional, Vidrio para mirar.

**PACS:** 01.40.Fk, 42.15.-i, 01.50.H-

**ISSN 1870-9095**

## I. INTRODUCTION

Research has shown that analogical approaches can enhance students learning. For example the findings of the study indicated that the teacher use of a cart with wheels moving obliquely over different surfaces as an analogy for refraction of light in a Physics class successfully engendered conceptual change in student learning about the refraction of light [1].

In addition there are various proposals for teaching approaches and variety of multimedia tools.

In a virtual environment, like computer simulations the learner as the player can control and create situations. Whereas students can only engage in rule-based activities and practice their predictions .Furthermore computer simulations allow the learner to visualize and test their thinking [2].

Especially when two multimedia tools or software are gathered the teaching goals will be accessed easy.

The natural languages of science is synergistic integration of words, diagrams, pictures, graphs, maps,

equations, tables, charts, movies, simulations and other forms of virtual and mathematical expression. In respect of the teaching of light, the teaching about the nature and function of scientific models should occur at the same time geometrical optics is taught as the ray scientific model is used extensively [3].

In this plan we want students to summarize data from real-world situations by collecting, organizing, and analyzing data, draw statistical inferences from charts, tables and graphs. Use mathematical language and concepts to validate and communicate the solutions to given problems in oral written and graphic forms [4].

These goals of Physics education can be considered by using PowerPoint and Looking Glass software to teach optics. The see tool presented here is based on the Looking Glass (LG). Nevertheless, the fact that the demo of Looking Glass is available on the web, makes it an ideal choice through teaching Optics during the education time (about only one month in semester) for implementing this see tool. In this experiment the PowerPoint and Looking Glass software are gathered to teach optics in high schools .In this

way the photos from nature and images from LG software can gather and we can plan the lessons by students more attractive. The students are interested in this method, because the usage of this software is easy to learn. Specially, when the Optics lab comes to help us for learning Optics. Many learning activities can be devised using this software application with using camera and PPT (PowerPoint software) and real laboratory experiments. Because of financial and local limitation we try to use only demo version to show the using of electronic teaching does not need many possibilities.

In this plan, the photos from nature and images and movies from LG software and the diagrams and charts are created by PPT and movies from lab and nature can be gathered. In addition the concepts are created by students and it is more attractive. They plan their ideas about nature and express them in the virtual space, this individual activity make them to construct rather than receive. The main steps to plan this method are as follows.

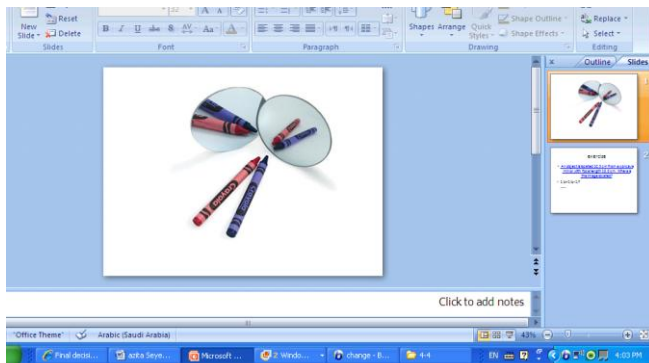
## II. PRODUCING MOTIVATIONS

At the first step the students are invited to see and find optical phenomena in the nature, the propagation, reflection and refraction of light. This observation helps them to be ready for the next step of learning optics.

Question:

Write two properties of the image of the concave mirror. (FIGURE 1)

Then students are encouraged to presents their answers about questions by taking photo using a camera. Different optics phenomena, including a reflection from plane or spherical mirrors, can be photographed by students. Pictures are presented immediately and the results should be understood by examining the model representation. The students take photos of interested images in mirrors and they can explain the differences between images. (FIGURE 1) The photos may be shown in a computer and video projector but we have a plan!



**FIGURE 1.** Photos taken by students to distinguish the differences between images in two kinds of mirrors

In this step the students try to do simple experiments and will suggest the relationship between distances of objects and images. The laboratory will be a journey of exploration of the mysterious nature of light. With experiments they study the straight propagation of light, the laws of reflection, refraction and the formation of images in the eye and the perception of distance.

## III. USING COMPUTER SOFTWARE IN OPTICS

In this step we want to choose a software to show Optics concepts were considered by students.

Some of the questions can help us to select the user friendly software are:

Is it easy to start using the software?

Are the design comprehensible and the image quality satisfactory?

Is the function of control elements evident?

Are the software requirements clear and of adequate proportion? [5].

When we use Looking glass all of answers are "yes", so it is a good choice to use it.

LG (Looking Glass) is a geometric optics construction set that allows students to create and explore situations involving several objects, lenses, mirrors and images. This software takes an interactive, visual approach to physics. Looking Glass will help students develop an intuition for the effect of lenses and mirrors on light rays. Students will gain a better understanding of the Optics behind the images. By creating and exploring their own lenses and mirrors with Looking Glass, students encounter many of the core concepts in optics. The students can change kinds of mirrors and distances and see the produced images, also they can check their answers for several kinds of images, depends on object distance from mirror, and also find the relation between  $p, q, f$  in spherical mirrors.

## IV. PLANNING AND SOLVING NUMERICAL OPTICS PROBLEMS

In this step students plan and solve problems of mirrors. In this way they can gain their abilities to organize concepts about Images in mirrors and its formula, how to use it to calculate  $q$  and predict the kind of image.

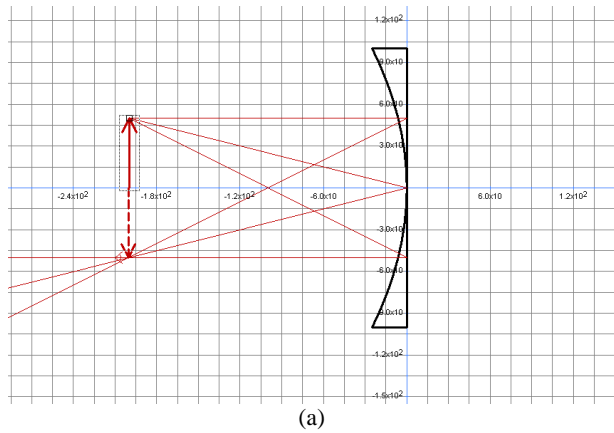
Many of image places in spherical mirrors can be predicted by Eq. (1):

$$1/p + 1/q = 1/f \quad (1)$$

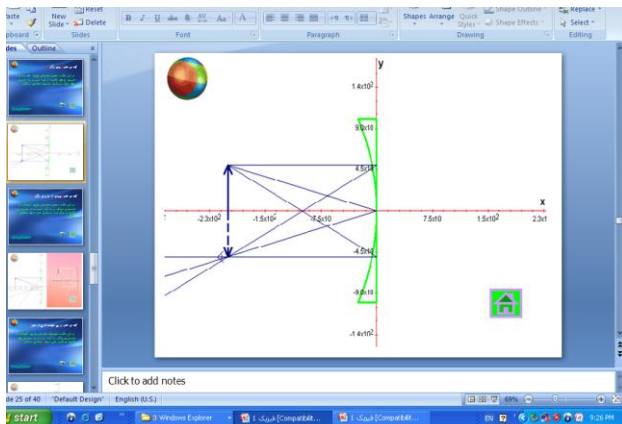
Mathematics is the strong device to find the relation between optical quantities. So in Optics' problems students use this equation. It helps students to understand the behavior of the light through using LG they can compare the mathematical results of solution and the modeling results of light and mirrors in this software. After that they can recognize their mistakes in solution.

In this step we suggest PPT to gather all concepts the students had understood.

PPT (PowerPoint) is a software with these abilities: Slide transition and animation, adding clip art, sound, movies to the presentation. A complex of all resources (is created by LG) and presenting it (by PPT), is the scientific way to use all of these languages in meaningful and appropriate ways, to be able to functionally integrate them in the conduct of scientific activity. There are strong commonalities in how individuals appear to think about the natural world.

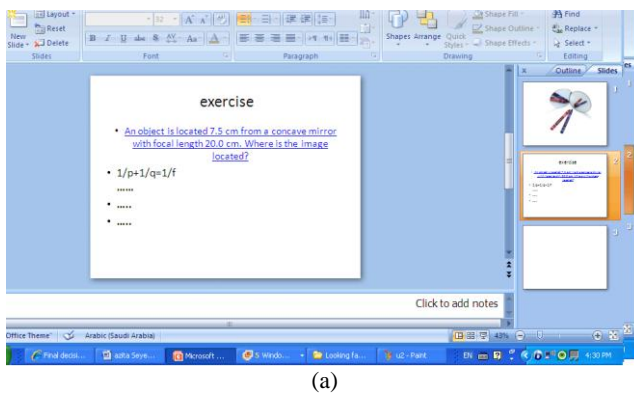


(a)

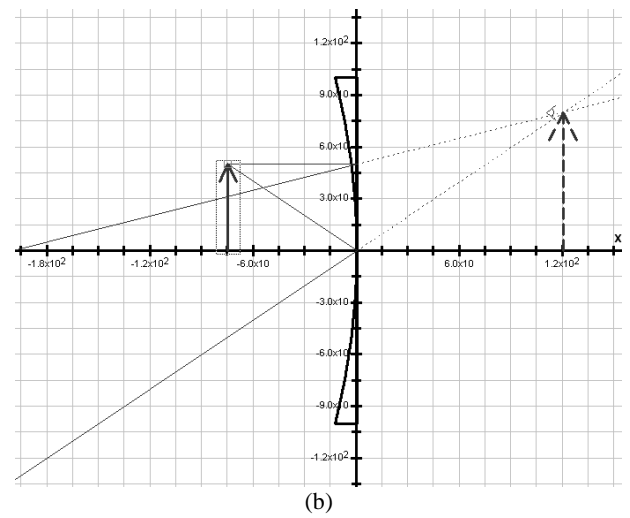


(b)

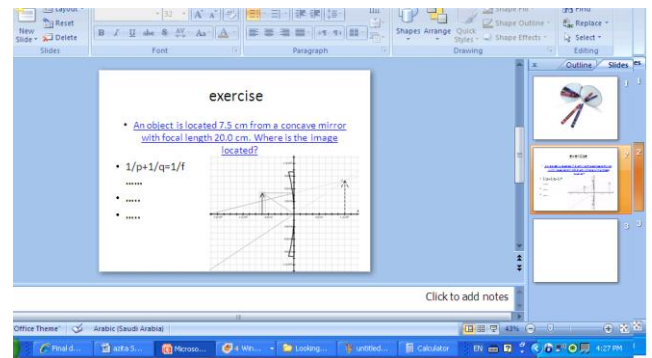
FIGURE 2. (a)A photo of the special kind of image in concave mirror in LG. (b) A print screen of LG on a PPT slide.



(a)



(b)



(c)

FIGURE 3. (a)A problem and its arithmetical solution in PPT. (b) Geometrical solution of problem by LG. (c)Presenting the comparison of two methods in PPT.

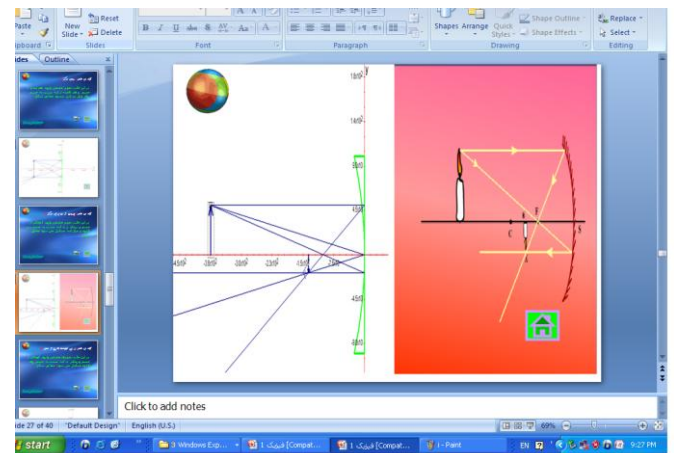
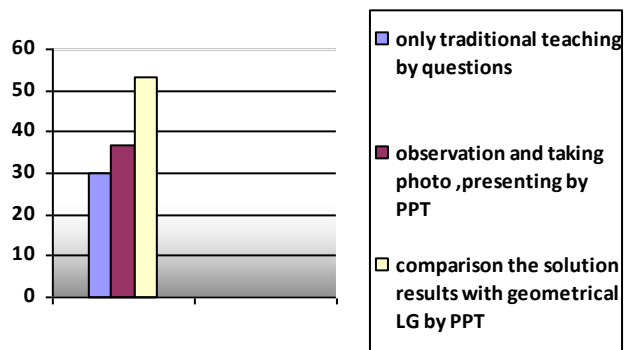


FIGURE 4. Comprison of a cartoon and model in LG on a PPT slide.

Learning scientific knowledge involves a passage from social to personal planes and the process of learning is consequent upon individual sense-making by the learner, learning is mediated by various semiotic resources, the most

important of which is language, graphics, pictures, photos, movies, simulations. They practice concepts by talking to others”, and they use it in talking to them in talking to their selves.



**FIGURE 5.** The percentage of students have answered correct to an arithmetical optics question through different methods and using ppt and LG.

## V. CONCLUSION

This method can help teachers to teach optics using contents and scenes from LG movies, allow convenient use in ordinary Physics classes, produce moving picture files by capturing scenes from LG. and they can motivate and help students understand Optics principles by collecting documents from LG, scanning materials, using cameras to

capture images, capturing and using digital video from nature and lab work, saving LG to media, saving information. And they can make students take part in the learning activities, and present PPT in class.

Results shows the understanding optics concepts could be easier by this method. Especially the comparison of arithmetical and geometrical solution of optics problems can help students to know their mistakes or misconceptions. Questionairs for understanding and finding the arithmetical solution and predicting the correct result for optics problems shows that this method is useful for teaching optics for students. (FIGURE 5)

## REFERENCES

- [1] Sandra, K., Abell, N., *Hand book of research on Science Education* (Lawrence Erlbaum Associates, New Jersey, 2007), p. 380.
- [2] Park, Y., *Teaching and Learning of Physics in cultural contexts*, (World Scientific Publishing, Danvers, USA, 2004) p. 324.
- [3] Hubber, P., *Year 12 Students' Mental Models of the Nature of Light*, Proceeding GIREP conference, (2006), pp. 355–361.
- [4] Wiley, D., *Creating E-Portfolios Using PowerPoint a guide for educators* (Sage Publication, L2004) p. 45.
- [5] Benedict, M., *Report and Recommendations on Available Multimedia Material for Teaching Optics at Schools and at University Level*, Proceedings of the European Workshop MPTL-8 (2003).