# The Methodology of Usıng Interactıve Electronıc Board in Learnıng Outcomes on Experımenatl Physıcs and Content in the Topic on “Lenses” in the 9th Grade

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**Abstract**

In the article, the method of using an interactive electronic board in the "Physics" class is shown, and the algorithm for preparing and conducting the lesson process using an interactive board had been considered. As an example, in the "Lenses" lesson, the method of using the electronic board in "teaching the results of experimental physics and content line" had been shown. In the teaching of the lesson, after students get acquainted with the structure and working principle of lenses, "How is the light beam controlled in optical devices?" and perform the study "Determine the main focal point of the lens". The first study is done visually through students. The second study is shown virtually on the electronic board with the support of the teacher. At this time, the "Ray optics simulation" web program is used. The program helps us determine the path of light rays and the focal length of lenses of different shapes. By doing experiments through the web application, students learn that by changing the radii of curvature of the spherical surfaces of the lenses, the value of the focal length of the lens also changes. At the same time, a lens with a smaller focal length refracts the rays more.

On the other hand, it was noted that many practical skills of students (computer use, virtual experiment, use of software functions, etc.) are developed in the teaching of "Experimental Physics and content line learning outcomes" using an interactive board. Interactive whiteboards allow students to easily use both animations and simulations. In addition, we can create the desired model and create an animation of the process using the figures on the toolbar, including devices for mathematical calculations and other functions. To use ready-made simulation modeling, we can place the simulation that we have prepared or downloaded from the Internet in resource libraries. In the article, at the same time, brief information was given about the disk with a laser flashlight developed by Professor Shukur Alizade to study light phenomena, as well as the model of the paths of light rays in the collecting and scattering lenses was prepared and shown.

**Keywords:** physics, teacher, student, converging lens, diverging lens, focal length, computer, interactive whiteboard, aktivlnspire program, Ray Optics Simulation

# Методологія використання інтерактивної електронної дошки в результатах навчання експериментальної фізики та змісту у темі «Лінзи» в 9 класі

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**Анотація**

У статті показано методику використання інтерактивної електронної дошки на уроці «Фізика», а також розглянуто алгоритм підготовки та проведення уроку з використанням інтерактивної дошки. Як приклад на уроці «Лінзи» була показана методика використання електронної дошки при «викладанні результатів експериментальної фізики та змістової лінії». На уроці, після ознайомлення студентів з будовою та принципом дії лінз, «Як здійснюється керування світловим променем в оптичних приладах?» та виконати дослідження «Визначити головний фокус лінзи». Перше дослідження проводиться візуально через учнів. Друге дослідження демонструється віртуально на електронній дошці за підтримки вчителя. На даний момент використовується веб-програма «Ray optics simulation». Програма допомагає визначити шлях світлових променів і фокусну відстань лінз різної форми. Виконуючи експерименти через веб-додаток, учні дізнаються, що зі зміною радіусів кривизни сферичних поверхонь лінз змінюється і значення фокусної відстані лінзи. Водночас лінза з меншою фокусною відстанню більше заломлює промені.

З іншого боку, було зазначено, що багато практичних навичок студентів (користування комп’ютером, віртуальний експеримент, використання функцій програмного забезпечення тощо) розвиваються під час навчання «Експериментальної фізики та результатів навчання змістової лінії» за допомогою інтерактивної дошки. Інтерактивні дошки дозволяють учням легко використовувати як анімацію, так і моделювання. Крім того, ми можемо створити потрібну модель і створити анімацію процесу за допомогою фігур на панелі інструментів, включаючи пристрої для математичних розрахунків та інші функції. Щоб використовувати готове імітаційне моделювання, ми можемо розмістити моделювання, яке ми підготували або завантажили з Інтернету, у бібліотеках ресурсів. У статті одночасно була наведена коротка інформація про диск з лазерним ліхтариком, розробленим професором Шукуром Алізаде для вивчення світлових явищ, а також була підготовлена модель ходу світлових променів в збиральних і розсіювальних лінзах і показано.

**Ключові слова:** фізика, вчитель, учень, збиральна лінза, розсіювальна лінза, фокусна відстань, комп’ютер, інтерактивна дошка, програма активний шпиль, моделювання променевої оптики

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**Introduction**.

One of the most effective tools for the formation of students' competence and skills is computer-supported smart boards. Smart boards help us make the lesson interactive, form creative and logical image thinking, as well as visual memory in students. Work experience proves that the figurative description of the event not only increases students' interest in the lesson, but also creates a desire to learn. The student wants to see the event rather than listen to it.

It is possible to carry out every operation carried out with the computer by means of an interactive board. At this time, didactic principles, interdisciplinary and intra-disciplinary integration, and the study of learning outcomes along the content line should be taken into account. In general, we know that a teacher must first know what to teach, under what conditions and with what means, and how to evaluate it. So smart boards are a tool for us to teach and learn.

**Formulation of the problem**. In the teaching process, the interactive board is mostly used during frontal, i.e., face-to-face work with students and involves detailed preparation for any lesson or its fragment (Solonevichev, 2010, p. 24). It is important to note that this board and the software provided for the use of the board are used when necessary and in the distance learning process. It is known that in the last year, in connection with the pandemic, smart boards and software that provide interactivity were used in tele-lessons and virtual school platforms.

**Main part**.

Firstly, take a look at the algorithm for preparing and conducting the lesson process through an interactive board (Solonevichev, 2010, p. 8).

• Determining the topic, purpose and type of the lesson, taking into account the interdisciplinary connection.

• Choosing the form of conducting the lesson (the forms can be completely different: seminar, business games, quizzes or training, etc.).

• Establishing the structure of the lesson, defining the stages in which the tools and the interactive board will be used.

• Determining the expediency of using interactive equipment compared to traditional tools in a specific lesson.

• Selection and preparation of interactive-didactic material.

• Selection and preparation of materials to be distributed to students (if required).

• Preparing a detailed plan of every minute of the lesson.

• Preparing students to master the lesson using interactive equipment.

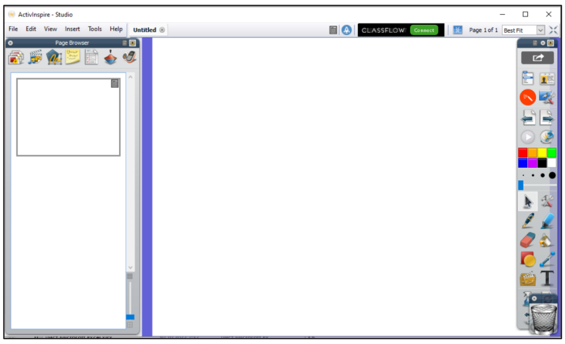
• Lesson approval.

• Lesson analysis and discussion.

In addition, it is necessary to know that using an interactive whiteboard and software intended for work with students, the age appropriateness of information and the characteristics of individual reception should be taken into account during the preparation and presentation of presentations (Solonevichev, 2010).

I would like to emphasize that in the teaching of the lesson example shown below, activelnspire software designed for the use of the Promethean interactive electronic board was used (Fig. 2).

*Picture 1. Promethan interactive whiteboard*



*Picture 2. Activlnspire interactive software*

By using the electronic board (picture 1) as a learning tool in teaching the lesson, the student achieves the learning outcomes of the experimental physics and content line according to the sub-standards given below.

**Sub standards**:

3.1.1. It uses devices relevant to electromagnetic (magnet and light), atomic and nuclear phenomena.

3.1.2. Electromagnetic (magnet and light), determines the dependence between physical quantities corresponding to atomic and nuclear phenomena.

**Learning outcomes** :

• Differentiates collecting and scattering lenses according to their structure

• Classifies the main elements of lenses and shows them in diagrams Presents results from experience. (Murghuzov, 2020, p. 140).

Topic: “ Lenses”.

**Aim of the lesson**: Studying the properties of the lens. Formation of the ability to construct images in lenses.

**Motivation**: In order to attract the student's interest to the subject, first of all, it is necessary to direct his thinking to the optical devices he uses in everyday life.

For example, students have either encountered or heard about optical devices such as glasses, microscopes, cameras, telescopes, magnifiers. At this time, creating an interdisciplinary integration, I ask the following questions:

T. Children, you worked with a microscope in biology class, you are familiar with a telescope, a few of you use glasses:

1. What is the common aspects all of these devices ?
2. Who can say about their importance in human life?

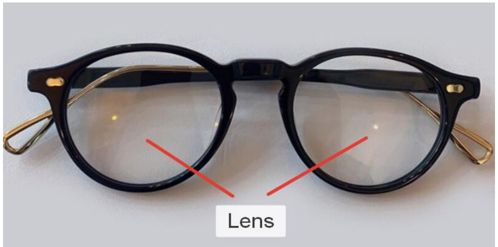



*Figure 3. The appearance of the lens in the glasses*

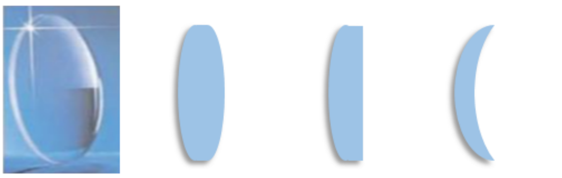
After the students' answers, the teacher gives the following information.

T. Each of you has knowledge about what glasses are used for. So you know that different glasses are made for each person. The clear piece of glass used in glasses and other optical devices for near and far vision is the lens (Fig. 3).

Lenses differ according to their types and materials. Lenses are transparent bodies bounded by spherical surfaces.

Lenses are convex and concave in shape.

Convex lenses are lenses that are thicker in the middle than the edges (Fig.4).



*The appearance of a convex lens* *Dooble convex lens* *Plane- convexs lens* *Converging meniscus*

*Figure 4. Convex lenses*

Concave lenses are lenses that are thinner in the middle than at the edges (3, p.145) (Fig5).

*Appearance of a concave lens* *Dooble concave lens* *Plane -concave lenc* *Diverging meniscus*

*Figure 5. Concave lenses*

After a short information about the lenses, the students were asked, "What is the path of the light ray falling on the lens?" is asked.

Their assumptions about the question are listened to and research is carried out.

Research question: How is the light beam controlled in optical devices? (Murghuzov, 2020, p. 140.)

Conducting of research: Students are divided into four groups. And each group of students conducts the following experiments. During the research, the teacher guides the students. If there is a lack of equipment in the school laboratory, as well as in order to save time, the experiment can be carried out collectively.

Supply: Laser flashlight disc (consists of a white board with a laser flashlight disc scale, a stand, and a laser flashlight with a magnetic base. There is no need to darken the room when using this device. Note that this device was developed by Professor Shukur Alizadeh), convex and convex lenses.

Work progress: Work progress is presented on the electronic board.

1. Place the convex lens vertically in the center of the laser beam disc by means of magnets.
2. First, by pressing the button of the laser flashlight, shine the beam in the center of the convex lens (picture 6 (a).
3. Then press the button of the two laser flashlights at the same time and shoot parallel rays from the edges of the lens to its main optical axis (Image 6 (b).
4. In both cases, observe the path of the rays after refraction through the lens.

**a** **b**

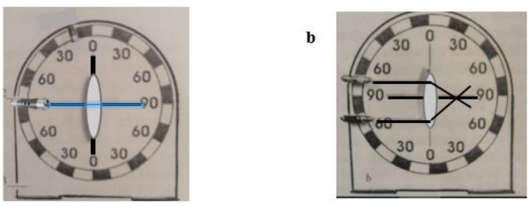


*Image 6. Parth of a ray through a laser curved disc after passing of ray through a convex lens*

5. Replace the converging lens with the diffusing lens and repeat the experiment.
6. After the rays are refracted from the center of the lens, measure the distance to the point where they intersect with a display meter. Discuss the result and write in the notebook.

Immediately after the experiment, the study "Determine the focal point of the lens" is conducted. At this time, the teacher shows and explains the experience on the interactive board.

Təcrübə “ Ray Optic Simulation” veb proqramında aparılır. Proqram 2D həndəsi optik səhnələr yaratmaq və simulyasiya etmək üçün pulsuz , açıq mənbəli veb proqramdır (Murghuzov, Abdurazagov, Aliyev, & Aliyeva, 2020). Bu proqramda işıq hadisələrini numayiş və tədqiq etmək çox əlverişlidir. Eyni zamanda proqram dilinin dəyişilməsi üçün Google Browser allows translation to any language. To use the web application, please post a link to the filipchat app on the Promethan board in advance. To place a website link on a page, follow the sequence below (Fig. 7).

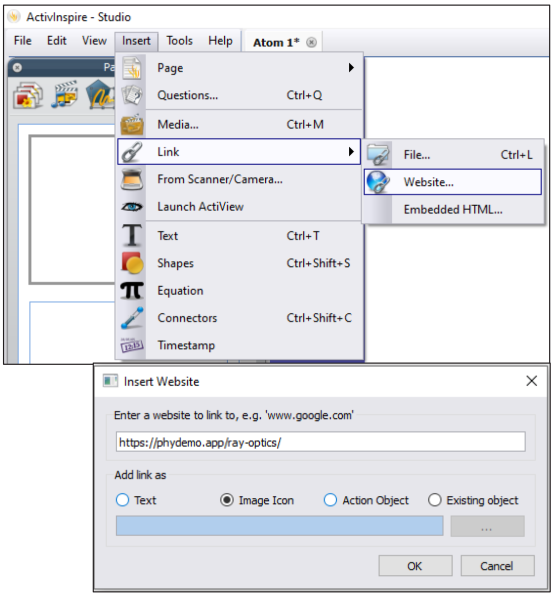



*Image 7. İnsert of hyperlink to website on "Actvlnspire" software*

1. Remove the link speed of the web application (CTRL+C).

2. Follow "Insert + Link + Website" in Activlnspire programme.

3. "Enter a website to link to, e.g. Add to 'www.google.com' section and select "image icon". Tap the "OK" button.

At this time, by tapping on the icon that appears in the browser, the web program will be opened.

To work in the program, we activate the "Tools+ Desktop Annotate" tool from the menu. This form of work allows you to work on the screen.

The workflow in the Ray Optic web application is as follows:

1. From the File section, click on the Examples section and select the suggested "Convex lens" (Image 8).

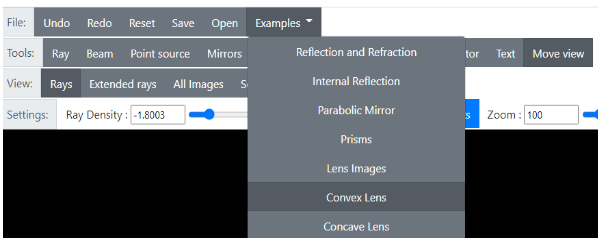



*Fig. 8. Workflow for using lenses in the "Ray Optic Simulation" software*

2. Immediately after the selection, the path of light rays falling on the lens will be visible on the stage (Fig. 9).

To determine the focal point and focal distance of the lens, we use the "Tools+pen" or figures section of the activlnspire program. To use any shapes and lines, select "Shapes + line" from the "Insert" panel. On the other hand, if you want to use a ruler, you need to implement the sequence "Tools+maths tools+ruler" in the program.

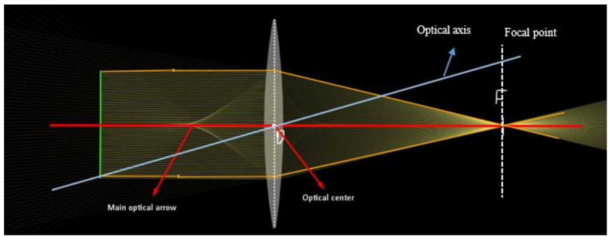



*Fig. 9. Determination of focal length in a convex lens*

In the opened simulation, the teacher shows that the straight line passing through the center of the spherical surfaces bounding the lens is the main optical axis of the lens, and the center where the light rays falling on the lens are refracted is called the optical center and is denoted by the letter "O". (Fig.9).

- The plane perpendicular to the main optical axis from the main focal point of the lens is called the focal plane.

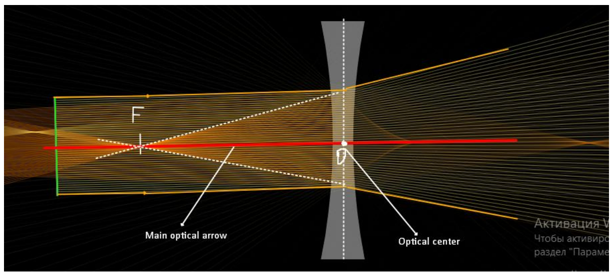



*İmage 10 (a). Determination of the focal length of a concave lens*

- In a convex lens, the light rays falling parallel to the main optical axis are refracted and the point where they intersect is called the main focus of the lens and is denoted by the letter F. The principal focal point of a convex lens is real because at that point the rays refracted in the lens intersect (Murghuzov, Abdurazagov, Aliyev, & Aliyeva, 2020) (Fig. 9).

- In a convex lens, the point where light rays parallel to the main optical axis intersect after refraction is called the main focus of the diverging lens. The principal focal point of a concave lens is imaginary, because at that point the extensions of the refracted rays intersect in the lens, not the rays themselves (Murghuzov, Abdurazagov, Aliyev, & Aliyeva, 2020). (Fig. 10(a).

The distance from the optical center to the focal point is called the focal length. If we shoot the light rays from both sides of the lens, we will see that the value of the focal length is the same. We measure the price by bringing up the ruler tool in the mathematical tools of the "Activlnspire" program.

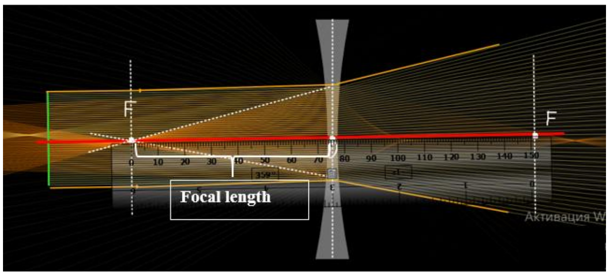



*İmage 10 (b). Determination of the focal length of a concave lens*

On the other hand, by changing the radius of curvature of the spherical surface of the lens, the teacher entrusts the determination of the focal distance to the students after the refraction of the light rays falling on it. Any student is invited to the board and by changing the shape of the lens, the change in the focal distance after the rays are refracted through the lens is observed by the students.

Exchange of information: Students summarize their results and exchange ideas with each other. The obtained results are recorded in one place.

Discussion of information: At this stage, a discussion is held on the experiments carried out. The teacher asks questions based on the results obtained from the experiments. Each student's opinion is summarized and a conclusion is drawn.

**Conclusions**.

The obtained result is presented to the students on the electronic board and the students get new information.

As a result of the experiment, it was obtained:

1. Lenses have the property of concentrating or scattering the light rays falling on them at a point after refraction. It is for this reason that people use it to see near and far.

2. Convex lenses collect parallel light rays falling on them at a single point after refraction. Such lenses are called converging lenses. Lenses that scatter light rays after refraction from the lens are convex lenses. Such lenses are called diffusing lenses.

3. Light rays do not undergo refraction when they pass through the optical center (Murghuzov, 2020, p.146)

4. Experience shows that the focal length of the lens depends on the radius of curvature of the spherical surfaces.

Focal length is the main characteristic of a lens, which determines the degree of refraction of rays as they pass through the lens. A lens with a smaller focal length refracts the rays more (Murghuzov, 2013, p.138)

5. Each lens has two main focal points. In a homogeneous medium, these points are equally spaced on both sides of the lens.

The lens whose thickness is very small compared to the radii R1 and R2 of the spherical surfaces is called a thin lens. The principle scheme of the elements of the collecting and scattering lenses is as follows.

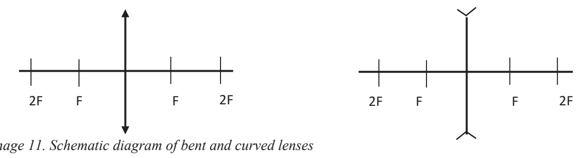



*İmage 11. Schematic diagram of bent and curved lenses*

There is another quantity that characterizes the degrees of refraction of lenses. That quantity is the optical power of the lens (Murghuzov M. 2013, p.138).

The inverse value of the main focal length is called the optical power of the lens. The unit dioptre (1 dptr) is adopted in Bs.

$$D = \frac{1}{F}$$

**Creative application**. At this stage, students use the textbook "What did you learn?" " in the section "Write the appropriate word in keywords instead of dots" task. (2a Murghuzov M., p. 148). The task is accomplished as a result of teamwork. The task uses the "Action Browser" function of the "ActivInspire" program. Hiding the correct answer with the help of this function and revealing it with one touch will eventually attract the attention of the students.

**Recommendation**: I recommend to use this form of work in the e-textbook as well.

The mechanism of the work as follows: The model is pre-made and stored in the "My Resources" section of the program (the sequence is shown in red frames (Fig. 12).

"Shape" and "Text" tools are used in the Tools toolbar to create the model.

1. A model of the lens is built in Filipchat.

2. The elements of the lens are marked with numbers and the names of the elements are written in front of the numbers ( insert+text).

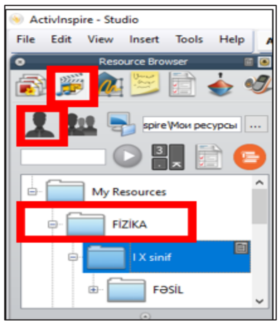



*Image 12*

3. Digital square is selected and follows such as: “Action Browser +Current Selection + Hidden” (Fig.13).

4. it is clicked to the “Action Properties ” section.

5. After tapping the two-dot frame in front of the Target section, the Select Object page opens

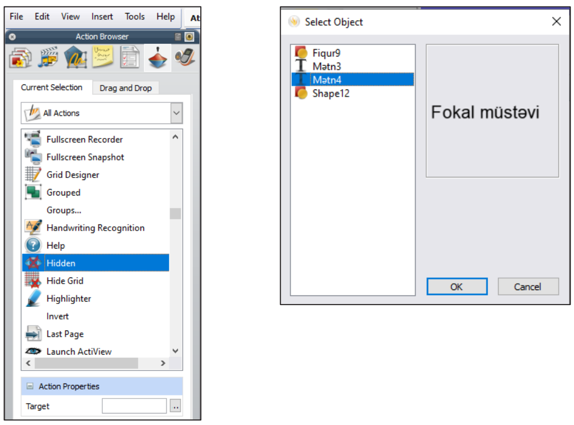



*Image 13*

6. On the page that opens, select the name of the object and activate the "Ok" button.

7. Activate the function by tapping on the text "Apply Changes".

8. Repeat the sequence for all numbers.

As a result, by touching each number, the name of the elements of the lens will appear on the screen (Image.14, 15).

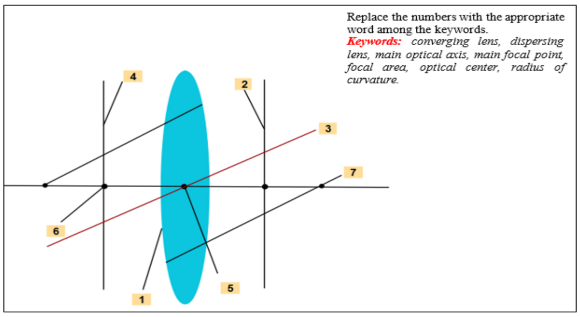



Figure. 14

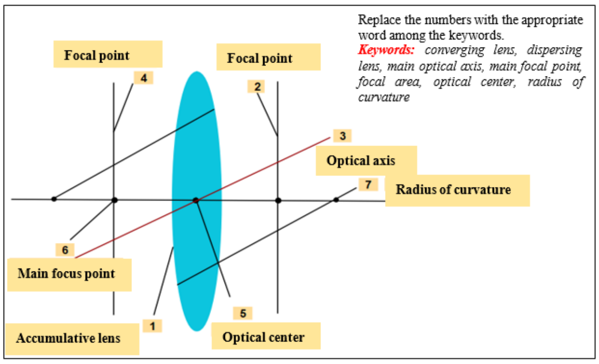



Figure. 15

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