

THE USE “INDIKASI WARNA” AS MODEL OF FAST FEEDBACK METHOD IN PHYSICS LEARNING ON FORMING IMAGE IN LENSES

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INTRODUCTION

Based on Permendiknas No. 41 – 2007 about National Education System that the total students in a class are limited into 32 students [8]. In fact is there are many classes that have more than 32 students. Because of it, the teacher often find difficulties to take care about student development in understanding the materials.

Evaluations such as assignment and exam spend long time to do correction, moreover if there are a lot of students. And the impact is teachers are late to know students' understanding toward material. In many cases, the learning process goes continually so students haven't got enough understanding the previous material will not get remedial learning. In physics, the materials that are transferred to the students usually in

correlation each other. If the previous material hasn't been understood by the students, they will find difficulties to understand the next material. So, there must be a strategy to evaluate in order to get students' weaknesses and do remedial learning [1]. To overcome the problem about the length of correction, there is fast feedback method. Fast feedback method is an evaluation technique which the correction process can be done in the short period and it can do during the learning process. With this method, the teacher can get the students' ability toward materials and if there is wrong concept, the teacher can give the remedial learning immediately [2].

Research about this method has ever been developed in some models. There are “klasikal”, “peer to peer to support in group”, “stick cards”,

“papan angkat” and “grouping answer” in some physics materials by some researchers. In this research has been developed the model of fast feedback method named “indikasi warna”. In this model, teacher is looking for students’ different answers then sticks it on the Styrofoam which has been given colored paper as answer indicator. The other students which have the same answer lift their paper in the same color. With this method the teacher can quickly see the variation of students’ mistakes and count the students’ right and wrong answers to go further.

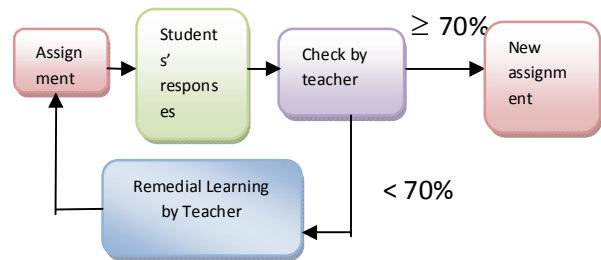
The problem that being observe in this research is “Does the indikasi warna as model of fast feedback method can be applied in large class to get feedback quickly?”

The advantages that we can get from this research are (i) help teacher to arrange effective learning (ii) the students’ difficulties can be overcome by teacher (iii) in order to make teachers get more understanding about the important of feedback which directly lead into school quality.

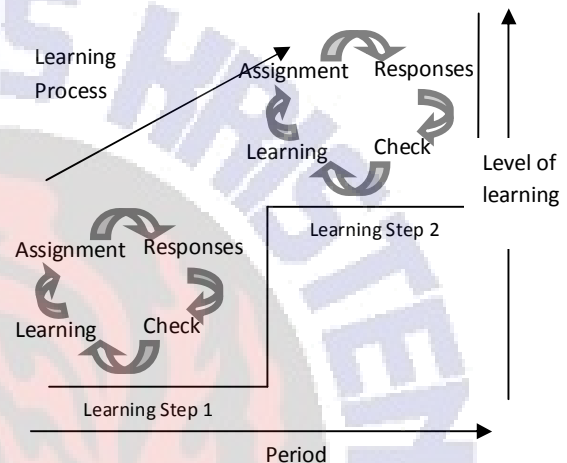
INSTRUMENT & RESEARCH METHOD

Data collector instruments : (i) **assignment card** : to know the students’ responses toward the assignment (ii) **lesson plan**: as the main reference in teaching (iii) **observation sheet**: to know the learning process. Sample : The students from X grade Senior High School.

Research method: Classroom Action Research by placing teacher as researcher. The teacher decide the problem that will be observe (planning), decide actions to solve the problems (action), apply the action plan (observe) and reflect the action that has been done (reflection) [7]. The procedures of research: (i) **Preparation**: make assignment card, indicator papers, lesson plan and observation sheet. (ii) **Implementation**: teacher does the preparation. From the students receive assignment, do the assignment until the teacher going around to check the answers is 1 feedback cycle. The students are given new assignment if 70% and more of students are correct and if less than 70% of students have right answer they are given remedial learning appropriate lesson plan.



Picture 2. Diagram of cycle of fast feedback method.



Picture 3. Diagram of learning process uses fast feedback method

(iii) **Observation**: people do the observation and write it into observation sheet in order to know the effectiveness of learning. (iv) **Reflection**: students’ answers and observation sheets are analyzed. Percentage of students’ right answer can be got as:

$$\text{percentage of right answer} = \frac{\sum \text{students' right answer}}{\sum \text{students}} \times 100\%$$

The data gained has been analyzed in form of qualitative descriptive for every step of learning. This research success if:

- 1) At least 70% of students give good response.
- 2) At least 70% of students have right answer.
- 3) Time spent for 1 feedback cycle 10 minutes maximum.

RESULTS AND DISCUSSION

The data from this research is shown in Table 1.

Table 1. Step, Cycle, Time and Students’ result of study

Step	Assignment	Time for 1 feedback cycle		% right answer
		Allocations	Reality	
1	1	10'	7.57'	56,67%
	2	10'	8.10'	30 %
	3	10'	7.37'	83,33 %
2	1	10'	9.44'	30 %
	2	10'	8.10'	93,33 %
	3	Not Necessary		
3	1	10'	7.27'	76,67 %
	2	Not Necessary		
	3	Not Necessary		
	4	Not Necessary		
4	1	10'	9.11'	66,67 %
	2	10'	9.30'	80 %
	3	Not Necessary		
	4	Not Necessary		
5	1	10'	9.04'	76,67 %
	2	Not Necessary		
	3	Not Necessary		
	4	Not Necessary		
6	1	10'	9.00'	83,33%
	2	Not Necessary		
	3	Not Necessary		
	4	Not Necessary		
7	1	10'	8.23'	63,33%
	2	10'	7.22'	73,33%
	3	Not Necessary		
	4	Not Necessary		
8	1	10'	9.37'	70%
	2	Not Necessary		
	3	Not Necessary		
	4	Not Necessary		
9	1	10'	7.10'	0%
	2	10'	9.03'	83,33%
	3	Not Necessary		
	4	Not Necessary		

The data are analyzed per step of learning per assignment which has been answered by the students.

Analysis For Every Step of Learning

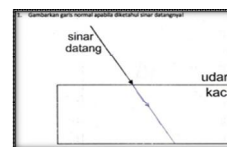
Learning Step 1

Indicator: students can draw normal line in the flat boundary.

Assignment 1

56,67% of students had right answer. It is perpendicular into flat boundary exactly hit the top

of incident ray. 43,33% of students had wrong answers. The answers are: Students had not known the existence of normal line. Time for 1 feedback cycle in this assignment was 7 minutes and 57 seconds.



Picture 4

Remedial for students' wrong answers is the observer explained

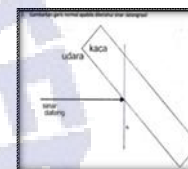
the purpose and how to draw normal line. Observer used 90° of triangle ruler to draw normal line. The study went to second assignment.

Assignment 2

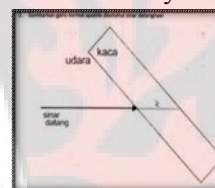
30% students had right answer, it is perpendicular into flat boundary and rightly hit top of incident ray.

70% of students had the wrong variation answers :

50% of students answered like in picture 5. They thought that normal line is a vertical line but actually the normal line is perpendicular into flat boundary and rightly hit top of incident ray.



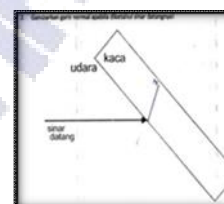
Picture 5



Picture 6

16,67% of students answered like in picture 6. They thought that normal line is same with refractive ray and didn't understand the existence of normal line to help drawing refractive ray.

3,33% student answered like in picture 7. Student didn't use the right basic to draw normal line.



Picture 7

Time for 1 feedback cycle to this assignment was 8 minutes and 10 seconds.

Analysis of Learning Process

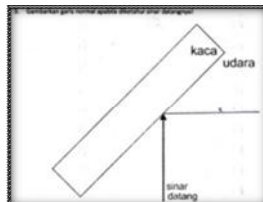
The students who had the right answer decrease into 26,67% and the learning must be repeated. The students didn't know about flat boundary and normal line should perpendicular into the incident ray or flat boundary. There were also students who had opinion about normal line is always vertical. The observer repeated the meaning of flat boundary,.

Learning went to assignment 3.

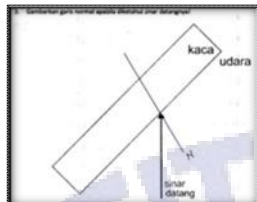
Assignment 3

83,33% of students had the right answers, it is perpendicularly into flat boundary rightly hit the top of incident ray.

16,67% students had the wrong variation answers :



Picture 8



Picture 9

6,67% students answered like in picture 8. They thought that normal line perpendicularly into incident ray but the normal line perpendicular into flat boundary rightly hit the top of incident ray.

10% students answered like in picture 9. When they were drawing normal line they did not give attention to angle between flat boundaries and normal line, it should be 90° formed angle. Time for 1 feedback cycle in this assignment was 7 minutes and 37 seconds.

Analysis of Learning Process

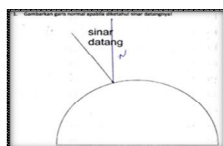
In the assignment 3, the total of students who had the right answer increased into 53,33%. Students didn't think that normal line is a vertical line which hit the top of incident ray anymore. It means, the learning was given by observer after second assignment is success. But, there were 5 students who could not exactly draw normal line.

Learning Step 2

Indicator : Student can draw normal line into curve boundary.

Assignment 1

30% of students had the right answer, it is perpendicularly into tangent from that curve rightly hit the top of incident ray.



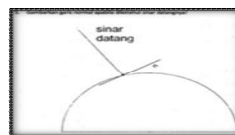
Picture 10

70% students had the wrong variation answers :

33,33% of students answered like in picture 10. They thought that normal line always been vertical without give attention to the

boundary but, normal line in curve must be perpendicularly into the tangent. The tangent is a

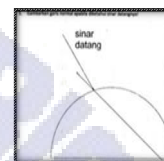
perpendicular line into the line which is pulled by from radius of curve. Normal line is drawn perpendicularly into tangent.



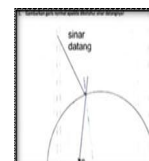
Picture 11

perpendicularly into tangent.

6,67% of students answered like in picture 12 and 3,33% of students like in picture 13. Students didn't have the right basic



Picture 12



Picture 13

to draw normal line in curve.

Normal line in curve must be perpendicularly into tangent and rightly hit the top of incident ray.

Time for 1 feedback cycle in this assignment was 9 minutes and 44 seconds.

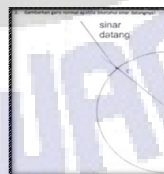
To remediate students' mistakes, observer did a demonstration with passing the ray from the air to the curve glass. The observer also explained the way to draw normal line in curve like in lesson plan.

The learning went to the assignment 2.

Assignment 2

93,33% of students had right answer. The answer is perpendicularly into tangent and rightly hit the top of incident ray.

6,67% of students had the wrong variation answers:



Picture 14



Picture 15

3,33% student answered like in picture 14. Student did not give attention to boundary. The

boundary from that curve must be perpendicularly from the line which is pulled from the point of curve.

3,33% student answered like in picture 15. Student didn't use the right basic to draw normal line. Student drew the boundary did not perpendicular with the line which is pulled from the point of

curve but actually the boundary must be perpendicularly into the line which is pulled from the point of curve. Student also did not have the basic to draw normal line. The normal line in the curve must be perpendicularly into boundary from that curve rightly hit the top of incident ray.

Time for 1 feedback cycle in this assignment was 4 minutes and 57 seconds.

Analysis of Learning Process

The students who had the right answer increased into 63,33%. Students did not draw normal line as vertical line without pay attention to the surface, perpendicularly into the incident ray and have been applied the right basic to draw normal line in the curve.

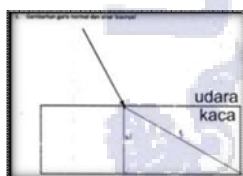
Learning step 3

Indicator : Student can draw normal line and refractive ray from incident ray which passed different density medium.

Assignment 1

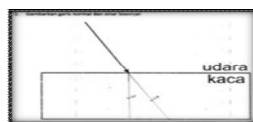
76,67% of student had the right answer and the answer is refractive ray approached normal line.

30% of students had the wrong variation answer :



Picture 16

3,33% of students answered like in picture 16. Students did not have the right basic to draw refractive ray which came from the distantly spaced medium to the dense medium. In the air the velocity of light is "c", while in the glass the velocity of the light decreases and makes the light bends approach the normal line to get shortest time to the bottom of the glass. By snellius law, where the refractive index of glass is bigger rather than refractive index of air can be gotten refractive angle smaller than incident angle.



Picture 17

13,33% of students answered like in picture 17. Students thought that the velocity of light in the air and glass are same. But actually, the velocity of light in the glass decreases and it makes light bends to get the shortest time to the bottom of glass. By snellius law, where the glass refractive index is bigger rather than air refractive index, so

refractive angle is smaller rather than incident angle (refractive ray approach the normal line).

Time for 1 feedback cycle in this assignment was 7 minutes and 27 seconds.

Analysis of Learning Process

In the third assignment, students had right answer in drawing normal line on the flat boundary although they are wrong in drawing refractive ray. Students have understood the purpose of normal line is to help deciding refractive ray address from the incident ray which passed the different density medium.

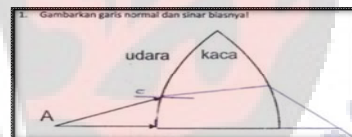
Learning step 4

Indicator : Student can draw normal line and refractive ray from incident ray which passed different density medium.

Assignment 1

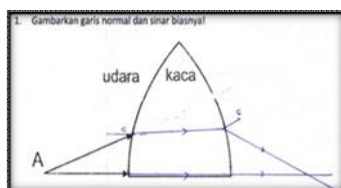
66,67% students had right answer. It is the ray which goes to the bottom of the glass continued to the outside of the glass and the ray which goes to the middle of glass when encounter the glass is bent approach the normal line and when goes to the outside of the glass, it keeps away from normal line. Both of those the refractive rays meet in a point.

33,33% of students who had the wrong variation answers :



Picture 18

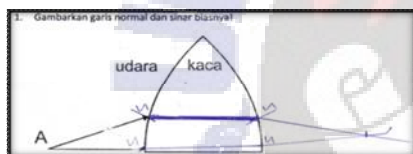
10% of students answered like in picture 18. Students thought that normal line is horizontal toward glass surface but actually normal line should be perpendicular toward the tangent. Refractive ray which encounter the glass has been drawn correctly, it is approaching normal line. For the incident ray which goes to near of the bottom of the glass students thought that they did not need to draw normal line and refractive ray because the incident ray from the air is forming 0° toward the normal line and rightly placed in the bottom of the glass. But actually, the incident ray from the air did not rightly go to the bottom of the glass, so there must have been drawn the normal line, it perpendicular toward the tangent. Angle which was formed by the incident ray came to the normal



Picture 19

refractive ray also made 0° position toward the normal line (the ray was continued to outside the glass).

20% of students answered like in picture 19. In the incident ray which goes to the middle of the glass, student did not draw the normal line. But, student had understood to draw the refractive ray. It is when encounter to the glass, the refractive ray approach the normal line and when going to the outside of glass the refractive ray is keep away from the normal line. Students did not draw the normal line for the incident ray which went to near of the bottom of the glass, Students thought that they did not need to draw the normal line because



Picture 20

the existence of the normal line to help for drawing the refractive ray from the incident ray. Although the students had understood that angle which was formed between the incident ray and normal line is 0° , so that ray was continued.

3,33% of students answered like in picture 20. Students did not draw the normal line correctly. But, students had understood the principal of drawing refractive ray which went to the glass is approached normal line and the refractive ray which went to outside the glass kept away from the normal line although the normal line was wrong. The incident ray which came from the air to the bottom of the glass, students did not draw the normal line clearly. Student only wrote the symbol of normal line is "N". Student did not draw correctly the refractive ray, it is caused there is no normal line as reference. The refractive ray which came and went from the glass made 0°

line is 0° , so the

that normal line coincided with the refractive ray. But

actually,

position toward the normal line, the refractive ray also made 0° position toward normal line (the refractive ray which come and goes from the glass was continued). Both of those rays met in a point because they traveled in the same shortest time.

Time for 1 feedback cycle in this assignment was 9 minutes and 11 seconds.

For remediate the students' mistakes there is informed to draw normal line and refractive ray. It is informed too that the form of the glass in the question as a half of the form of convex lens.

Analysis of Learning Process

In this assignment the students had understood the important of normal line but some students did not apply it. In their answers, the students were not properly to take the tangent and or normal line. Refractive ray had been drawn correctly by the students. It is approaching the normal line when encounter the glass and keeping away the normal line when goes out. The learning goes continued to the assignment 2.

Assignment 2

73,33% of students who had the right answer, they drew the normal line perpendicularly toward the tangent. When the ray encounters the glass, the refractive ray approaches the normal line and when

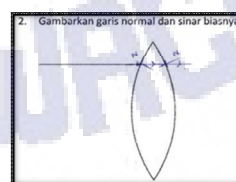


Picture 21

going out the glass the refractive ray keeping away the normal line.

26,67% of students who had the wrong variation answers:

13,33% of students answered like in picture 21. Students though that the velocity of the light in the

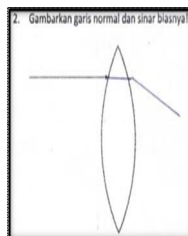


Picture 22

air were same with the light encountered the convex lens. So, the light was continued. But actually the velocity of the light in the glass decreased so it made the light bent approaching the normal line to get the

shortest time. By snellius law, could be gotten the smaller refractive angle rather than incident angle.

3,33% of students answered like in picture 22. They did not draw the normal line. Student did not use the right basic to draw the refractive ray which encounter and come out of the glass. So, the answer is inconsistent. When encountering the



Picture 23

glass, the ray should bend and keeping away the normal line. Student answered the refractive ray which encountered the glass was continued. This means the student argued that the velocity of the light in the air and the glass are same. When coming out of the glass, student drew the refractive ray bent. If the refractive ray went out of the glass and the normal line is drawn correctly there would be that refractive ray keeping away from the normal line.

6,67% of students answered like in picture 23. When encountered the glass, the students drew the tangent form the surface of the lens and drew the normal line. But, the tangent which was drawn by the students did not correct and it made the normal line incorrect. Student had understood that the incident ray from distance spaced medium to the dense medium would be bent approaching the normal line. When it came out of the glass, students also did not draw normal line correctly. The normal line should be perpendicularly toward the tangent of the surface of the lens. The refractive ray which drawn by the student was right, it is keeping away from the normal line.

Time for 1 feedback cycle in this assignment was 9 minutes and 30 seconds.

Analysis of Learning Process

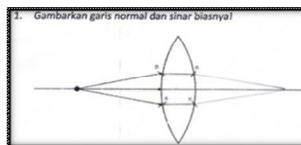
In the assignment 2, students who had the right answer increased into 6,66%. After given the learning most of students have drawn the tangent correctly, the normal line is perpendicular toward the tangent and refractive ray is when encountered the glass approaching the normal line and when coming out of the glass kept away from the normal line correctly.

Learning step 5

Indicator : Student can draw normal line and refractive ray from incident ray which passed different density medium.

Assignment 1

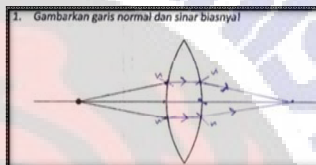
76,67% of students had right answered. They drew the normal line correctly. The ray



Picture 24

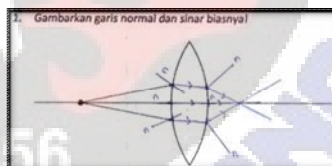
which come to the bottom of the glass was continued into the outside of the glass and the ray which goes to the middle of the glass when encounter the glass was refracted approaches normal line and when came out the glass is keep away from the normal line. Those three refractive rays met in a point.

23,33% students had the wrong variation answers: 3,33% of student answered like in picture 24. Student didn't use the correct basic to draw the normal line because they didn't draw the tangent from the surface of



Picture 25

from the surface of lens. But, student had known that refractive ray which encounter the glass approaching the normal line and refractive ray came out of the glass keeping away from the normal line because the difference of velocity of light at the air medium and glass medium. Student did not pay attention in answering the question so they did not drew the refractive ray from the incident ray which coincides toward principal axis.



Picture 26

10% of students answered like in picture 25. Students thought that they did not need to draw the normal line for the incident ray which coincide to the principal axis because the normal line also coincide to the principal axis and refractive ray. In the ray which came coincide with the principal axis encountered lens, the normal line also coincides with the principal axis so the ray was continued.

10% of students answered like in picture 26. Students were inconsistent to use the correct basic to draw the normal line. Two normal lines from the incident ray coincided with principal axis were correct. It is perpendicular toward the tangent of lens's surface. But, four of the normal line did not

perpendicular toward the tangent of lens's surface. But, student who had understood that the ray which encountered the glass approaching the normal line and the ray which came out of the glass keeping away from the normal line. Those three of refractive rays met in a point.

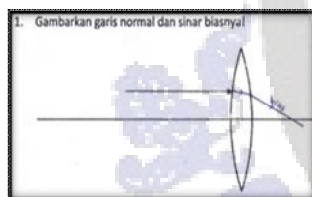
Time for 1 feedback cycle in this assignment was 9 minutes and 4 seconds.

Analysis of Learning Process

In this assignment most of students had answered correctly. Although in the 4 step after assignment 2 did not give assignment as confirmation but in this assignment student still understanding the principle of refraction. Students who answered right also increased into 3,33% although the concept which will be given in the step 4 and 5 are different. The concept was will be given in this step is the object is collection from the points of object, a point of object made a point of image. If there were collection of points of object there will be made collection of points of image.

Learning Step 6

Indicator : Student can draw normal line and refractive ray from incident ray which passed different density medium.



Assignment 1

83,33% students had correct answer. They drew normal line correctly.

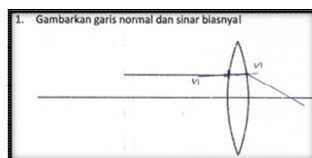
The ray which encounter the glass was refracted approach normal line and when came out the glass

Picture 27

keep away from the normal line.

16,67% of students had the wrong variation answers :

3,33% of student answered like in picture 27. Student did not use normal line. But if the normal

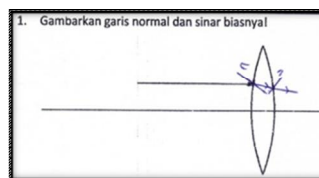


Picture 28

line was drawn correctly, so there would be the refractive ray which enter the glass approach the normal line and the refractive ray which come out of the glass is keeping away the normal line. Student also understood that

without drawing the normal line the ray would bend like in the picture above.

6,67% of students answered like in picture 28.



Picture 29

Students did not draw the tangent correctly and the impact is the normal line was wrong.

The refractive ray which encounter or come

out of the glass had been drawn correctly by the student. It is the refractive ray which encountered the glass is approaching the normal line and the refractive ray which come out of the glass is keeping away from the normal line.

6,67% of students answered like in picture 29. Students were inconsistent to use the correct basic to draw normal line. When the ray encounter, the students had drawn the normal line correctly, it is perpendicular toward the tangent but when the ray comes out of the glass the students did not draw the normal line correctly. If the refractive ray is analyzed by using normal line which had been drawn by the students so it had been drawn by the students was correct. It is refractive ray which encounter to the glass approaching the normal line (the refractive angle was smaller rather than incident angle) and the refractive ray which came out of the glass keeping away from the normal line (the refractive angle was bigger rather than incident angle). The meeting point from the refractive rays which came from the parallel rays with principal axis as one of approach from 3 special rays for the convex lens. It is ray came parallel toward the principal axis and was refracted by focus point.

Time for 1 feedback cycle in this assignment was 9 minutes.

Analysis of Learning Process

In the first assignment, 70% and more had the correct answer although in step 5 after assignment 1 was not given the learning. The concept which had been taught in step 5 and 6 were different but the students still understood the principle of refraction to answer the question in the assignment 1 step 6. The concept that had been given in this step is approaching of 3 special rays for convex lens.

Learning Step 7

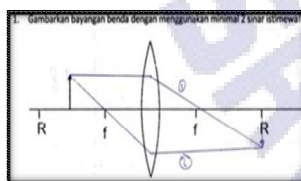


Picture 30

Indicator : student can draw the image from object using 3 special rays

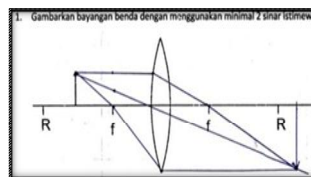
Assignment 1

In assignment 1 63,33% students had the right answer. It used 3 special rays in convex lens to draw the image. The draws of 3 rays were correct. 36,67% students had wrong variation answers : 13,33% of students answered like in picture 30. Students did not understand that they only need 2 from 3 special rays minimum which meet to draw the image. Special ray that sounds “ray comes parallel toward principal axis is refracted by the focal point” (next it’s called 1st special ray) did not draw correctly by the students. The ray should come exactly parallel toward the principal axis and with approach of thin lens, ray comes parallel and stop in the middle of the lens. Then the rays was continued to pass the focal point. The special ray sounds “ray comes to the point of curve of the lens, it is continued” (next it’s called the 2nd special ray) also did not draw correctly, the ray should come to the right to the middle of the lens and the ray was continued. The special ray sounds “ray comes to the focal point is refracted parallel toward principal axis” (next it’s called the 3rd special ray) also did not draw correctly by the student, the ray which was drawn was not exactly correct from the focal point. And the impact was that ray was not meet to the other of two special rays. The rays should come from the top of object is drawn right to the lens’s focal point. After the ray encountered the middle of the glass, that ray was refracted parallel to principal axis.



Picture 31

10% of students answered like in picture 31. Students did not pay attention to draw which made the 1st and 2nd special ray did not hit the focal point correctly. The ray which come out of the glass was little oblique, it should be parallel with the principal axis. And the effect of the image was wrong. The image should be placed in the right of the “R” lens and the size was bigger but

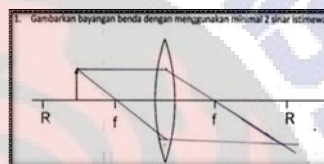


Picture 32

the students drew the image placed exactly in “R” and the size was the same.

10% of students answered like in picture 32. Students did not

understand that to draw the image only use the meeting point of two rays.. The 2nd special ray did not drawn correctly. The students forced the 3rd special ray in order to it meet with the other two previous rays. Students made a bit oblique the ray which went to the focal point. But, in the same medium the ray travels straight. Although the special rays were not perfect, but the students



Picture 33

could draw the image properly. It is arrow of the object is in the opposite position, the image should be placed in the right

of the “R” of lens and the size of the image was bigger.

3,33% of student answered like in picture 33. Student had been understood that two rays which meet were enough. Student could draw the 1st and the 2nd special rays. But, the student was in a rush and did not draw the image.

Time for 1 feedback cycle in this assignment was 8 minutes and 23 second.

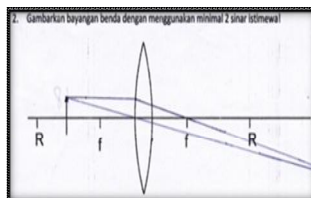
For the remediate the student’s mistakes, the observer used Crocodile Physics Animation. That animation could be set to inform the student that every point from the object is spreading light to any direction. But there was an agreement to draw image easier, it is taken 3 special rays which were named 3 special rays. The observer also reminded to the student to be more careful in drawing the third special rays. Learning was continued to the assignment 2.

Assignment 2

In the second assignment, 76,67% students had the right answer. It used 3 special rays on the convex lens to draw the image and make easier in drawing the picture was taken by the top and bottom of the object as the reference to draw image.

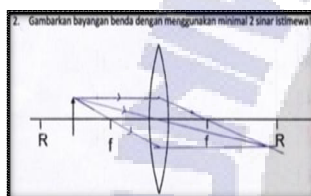
23,33% of students had the wrong variation answers :

3,33% of students answered like in picture 34. Student did not draw the image from the any point



Picture 34

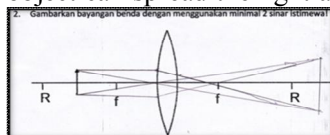
except the bottom of the object. This means students did not really understand that the object as the collection of the point which spread the light to the any direction. But for drawing the image in the question like this is to draw the image from the top until bottom of the object. Those two special rays did not really correct in drawing and it caused the meeting point placed very far so the image could not be drawn.



Picture 35

6,66% student answered like in picture 35. Students did not really understand that the object as the collection of the point which spread the light to any direction but for drawing the image in the question like this was to draw the image form the top until the bottom of the object. Those three special rays had been drawn correctly by the students but the students did not understand that for drawing the image only use two of meeting point rays. Students also did not draw the image which was formed by the meeting point of those three special rays. This is caused students realized that those rays only came from the top of the object. From the bottom of the object had not been drawn but the student did not quickly take an action to draw the image.

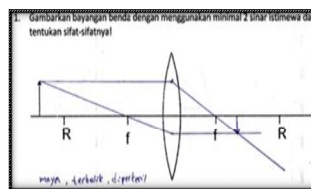
3,33% of student answered like in picture 36. Student had understood that in every point of the object can spread the light and these question only



Picture 36

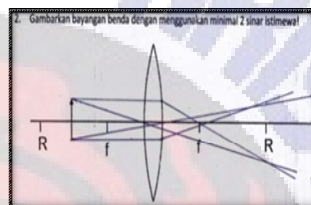
was drawn the top and bottom of the object. Student also had understood that only with two meeting point rays can be resulted as image. The top and the bottom

of the object were drawn using 3 special rays but the image of two special rays did not correct. It was the 1st special ray the refraction did not



Picture 37

correctly go to the focal point and 2nd special ray did not go to the middle of the lens but the student had drawn the image although the drawing of special rays was not correct. Because of student was not careful to draw which one the position of the top and the bottom of the object using arrow.



Picture 38

10% of students answered like in picture 37. Students had understood that in every object which spread the light and fro drawing the image only used two meeting point rays. But, because the students did not correctly draw the special rays student became confused to draw image. The point where two of rays were meeting which was drawn by the student the position was not straight. The position of the image should be from the point of the top and the bottom of the object was placed straight in a vertical line.

Time for 1 feedback cycle in this assignment was 7 minute and 22 seconds.

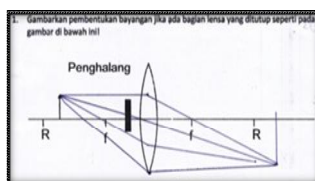
Analysis of Learning Process

In the second assignment the percentage student who had the right answer increased into 13,34%. After they were given remedial learning, most of them had understood that the object as the collection of the points which spread the light to any direction where for drawing the image only using two meeting point rays. For answering the question in assignment 2 step 7, most of students had been correct to draw the image only use two rays and draw the image from the top and the bottom of the object as representation of the complete image in an object.

Learning Step 8

Indicator : student can decide the characteristic of image which was formed by lens

Assignment 1



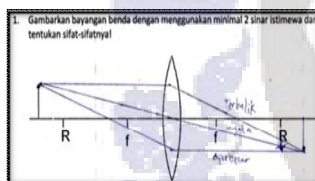
Picture 39

inverted, and smaller than object.



Picture 40

Student mentioned that the characteristic of the image is real, inverted and bigger than the object. Student didn't have correct reference to decide the characteristic of image which one the image was smaller or which one the image was bigger.



Picture 41

The image must be placed between "F" and "R" of the lens and smaller than the object. But, if it's analyzed by the image which had been drawn by the student, the student had been understood the mean of inverted, real and bigger than the object.

13,33% of students had answered like in picture 40. The students did not draw the 2nd and 3rd special rays properly.



Picture 42

the characteristic of image is inverted, real, smaller than the object.

70% of students had the right answer. The answer is made the image by lens use 3 special rays and the characteristic of image is real, inverted, and smaller than object.

30% student had the wrong variation answer : 3,33% of students had answered like in picture 38. Student did not draw the 1st and the 2nd special ray properly. But, the

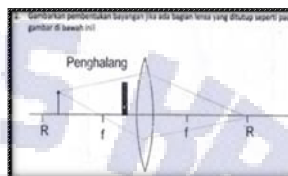
place of image was right. Student mentioned that the characteristic of the image is real, inverted and bigger than the object. Student didn't have correct reference to decide the characteristic of image which one the image was smaller or which one the image was bigger.

3,33% of students had answered like in picture 39. Student did not draw the third of special rays properly and the impacts were the place and the characteristic of image was wrong. The image must be placed between "F" and "R" of the lens and smaller than the object. But, if it's analyzed by the image which had been drawn by the student, the student had been understood the mean of inverted, real and bigger than the object.

13,33% of students had answered like in picture 40. The students did not draw the 2nd and 3rd special rays properly.

But, the image which was drawn was in the right place and was right to decide the characteristic of image.

3,33% of students had answered like in picture 41. The students were right in drawing the special rays. But, the students was wrong in deciding the characteristic of the image, it is virtual, inverted and smaller than the object. The students had not been understood the difference of real and virtual image. The image is called real if the ray which was formed the image and out of the optics instrument is convergent. The image is called virtual if the ray which was formed the image and out of the optics instrument is divergent. By experiment, the real image can be caught by the screen and the virtual image can't be caught by the screen.



Picture 43

Time for 1 feedback cycle was 9 minutes and 37 second.

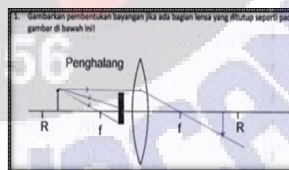
Learning Step 9

Indicator : student can draw the image from an object if there is a part of lens is closed.

Assignment 1

In the first assignment, there was none had the right answer. The variation of the students' wrong answers are :

50% of students had answered like in picture 42. The students use three special rays to draw the image. But actually, the 2nd and 3rd special rays couldn't continue because there is a block. Just the 1st ray which could go as usual but 1 ray wasn't enough to draw the image, two rays which met in a point were needed to draw the image. To draw the



Picture 44

image, it is enough to use 2 rays which spread from the top of the object to any direction which there is nothing a block. Use the concept of refraction, it is founded a point where the rays met.

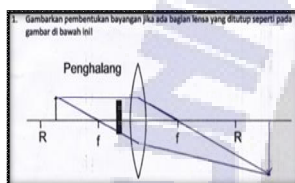
26,67% of students had answered like in picture 43. The students were not only use three special rays to draw the image but also added a ray which spread from the object to the bottom of the lens. If used the three special rays, so the 2nd and 3rd special rays can't go continually because there is a

block in front of the lens. But, the students thought that the ray could be absorbed by block and it would go continually. The refractive ray which came into the bottom of the lens did not draw correctly by the students. The refractive ray which encountered the lens would approach the normal line and the refractive ray which goes out the lens would keep away from the normal line.

23,33% of students had answered like in picture 44. The students used the

too draw the image. But actually, the 3rd special ray which had been drawn by the students can't go continually.

Time for 1 feedback cycle in this assignment was 7 minute and 10 seconds.



Picture 45

Basically, the students had been understood that of the lens was covered by something so the image is entire because they were taught in the previous learning that every point of the object spread the light in any direction and could make an image. Because of in the step 7 and 8 before, the students used 3 special rays to answer the questions. So the students used the three special rays to answer this question. The observer repeated the information that every point of the object is spreading the light in any direction, the observer only used 2 rays which spread to the random direct from the top of the object to draw the refractive ray. First, the observer drew the normal lines then drew the refractive rays which approaching the normal lines. After that, the observer drew the normal lines for the ray which went outside the lens and then drew the refractive rays which keep away from the normal lines. Both of the rays meet in a point and this point is representing the top of image as the complete image.

The learning was continued to the assignment 2.

Assignment 2

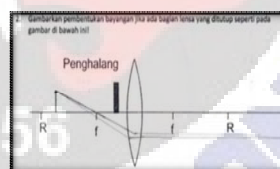
In the second assignment, 83,33% of students had the right answer. The answer is drawing image used the concept of refraction so

the image is entire and be placed in the right of "R" of the lens and it's bigger than the object.

16,67% of students had the wrong variation answers :

3,33% of students had answered like in picture 45. From the student's answer, the student did not answer the question seriously. To draw the image, we should use the tangent and the normal line. The way to draw the normal line is perpendicular toward the tangent, then draw the refractive ray. The refractive ray which comes to the lens is approaching the normal line and the refractive ray which goes to the outside of lens is keeping away from the normal line. Both of the refractive rays will meet in a point, if the source of the light is came from the top of the object so the refractive rays which met in a point is the image of the top of object.

13,33% of students had answered like in picture 46. The students had not been understood that if one of the three special rays so the others must be used three special rays too. If one of the ray is drawn by applying the concept of refraction, so the other rays must be drawn by applying the concept of refraction too. In this question, the 3rd special ray can be drawn but the other special rays can't be gone continually. For the 3rd special ray, the students drew it properly, for the ray which apply the concept of refraction the students drew it properly too. But, the students did not draw the



Picture 46

normal line but actually the normal line is important to decide the refractive ray which come and go from the lens. This inconsistent way to answer, it had

not the meeting point to draw the image. Time for 1 feedback cycle in this assignment was 9 minutes and 3 seconds.

Analysis of Learning Process

In the second assignment, the students who had the right answer increased into 83,33%. In the step 7 and 8 the students used three special ray to draw because it's an easier way to answer the question rather than used the concept of refraction. But actually, the three special rays can't be applied to answer the questions in step 9. After they were given the remedial learning, most of students had been understood the use of refraction

principals to the special case as question type in this step.

The Impact of The Use Fast Feedback Method in Learning Process

The use of fast feedback method can boost the student to visualize their thinking actively. It's shown by every student gave good response. But, mostly students like to be passive and just listen to the explanation from the observer. The use of fast feedback method also gave influence students' understanding. It is shown by percentage of students' right answer.

CONCLUSION

The conclusion of this research is the use of "indikasi warna" as a model of fast feedback method can help the teacher to know the level of students' understanding in a short time so the teacher can detect students' difficulties in order to be followed up by teacher.

Suggestions' :

- 1) This research is can be used in another materials.
- 2) The model of fast feedback method can be developed except "klasikal", "peer to peer to support in group", "stick cards", "papan angkat" and "grouping answer".

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