Journal of Applied Research in

Science and Humanities

The Impact of Educational Technology on Student Achievement

Asmaa Ahmed Abd El Shafy, Fatma Gamal Abd Elhamed, Habiba Ahmed Mahmoud, Hager Ihab Kamal, Mai Abdel Nabi Saber, Rahma Mohamed Mohsen and Sondos Ali Mekhimer

Supervisor: Dr. Adel Younes Elmekkawy – Lecturer, Department of Mathematics, Ain Shams University, Faculty of education.

Program title: Bachelor of Science and Education (Preparatory and Secondary) - Mathematics major (E)

Abstract

This research aims to study the impact of educational technology on students' academic achievement, as research has shown that when educational technology is used well, it can have a positive impact on student achievement. For example, the use of educational programs that provide immediate feedback can help students understand their mistakes. It improves learning outcomes, and this is what we found in this research. However, the effectiveness of educational technology depends on how it is implemented. If technology is not well integrated into the school curriculum and in a way that attracts students, it may not have a significant impact on student achievement. We also found that employing technology helps students cooperate with each other, which enhances communication skills in addition to participation and interaction in the educational process. We also found that educational technology helps to break away from the concept of traditional education, where the teacher was the main source of information, as traditional education depends on the method of teaching information to students. While educational technology helps in self-learning by searching for information from different sources, which leads to reducing the role of the teacher in the educational process.

Key Words:

Education technology, student achievement, math activities.

1-Introduction:

In light of the rapid and successive developments of the computer and its applications in various fields of life, it has become necessary for everyone interested in the educational process to make every effort to benefit from these developments in preparing educational programs in order to facilitate the understanding and assimilation of many curricula for students. Al-Mabaridi et al. (2020), Ali Darvishi et al. (2024), Gulsah Kacmaz , Adam K. Dub´(2022), Hassan Ibrahim Muhammad Abdullah (2021), Khadr et al. (2005), Phuong Bui et al. (2023) and Yanjun Pan et al. (2022). have shown that the use of educational technology it has a positive effect in increasing academic achievement.

Gulsah Kacmaz & Adam K. Dub´(2022) and Yanjun Pan et al. (2022). showed that mathematics games facilitated the learning mathematics and had a positive impact on the academic achievement.

Technology can be used in teaching mathematics in many ways which are:

1- Computer programs and sports applications

Computer programs and various digital applications can be used to communicate mathematical concepts in an interactive and interesting way. For example, graphing programs can be used to clarify engineering concepts, or application programs can be used to solve mathematical equations. Computer programs and digital applications can be used, for example.

Wolfram Alpha is a widely recognized artificial intelligence cognitive computational engine that excels in performing a wide range of mathematical operations, from basic arithmetic to calculus and linear algebra, where the user can enter equations, integrals, derivatives, and even word problems to obtain step-by-step solutions. It provides graphing capability making it a comprehensive tool for visualizing mathematical functions and data.

GeoGebra combines geometry, algebra, and calculus in a platform supported by artificial intelligence to enhance visualization and mathematical exploration. It enables the user to create geometric shapes, process equations, and verify mathematical relationships in a dynamic manner. Thus, it brings the student to a deeper understanding of mathematical concepts and encourages students to participate in meaningful mathematical exploration.

IXL through students interact with interactive questions that adapt to their level of understanding and learn from their mistakes with specific explanations after each question.

2-Educational games:

Educational games can be used to motivate students and enhance their understanding of mathematical concepts. Games based on mathematical activities can also be used to practice mathematical skills or interactive games to solve mathematical problems.

3- The World Wide Web

The Internet and its various resources can be used to provide additional sources for learning mathematics. Students can search for websites, videos, and other educational resources to expand their mathematical knowledge.

4-Smart devices

Smart devices such as smartphones and tablets can be used to learn mathematics, and various applications can be downloaded on these devices to help students solve mathematical problems and develop their mathematical skills.

5-Multimedia

Multimedia such as video and audio can be used to illustrate mathematical concepts visually and aurally.

2. The Theoretical Framework

It is clear from the previous presentation that there are many advantages of using technology in education, including, for example, as shown in study Joe Hazzam and Stephen Wilkins. (2023), enhancing participation between the lecturer and the student via the Internet

Benefits of educational technology

1- Achieving educational goals with high efficiency and economy of effort and time.

2- Achieving learning in an interesting and enjoyable manner.

3- Providing sources of information that can be accessed at any time.

4- Providing the teacher and learner with motivation to keep pace with the times and the continuous progress in technology.

5- Increasing the possibility of communication between the student and the teacher.

6- Easy access to the teacher

7- Solving the problem of increasing numbers and narrow halls.

8- Multiple teaching methods

9- Providing the learning feature at any time.

10- Reducing the cost of learning and making it accessible to everyone.

11- The teacher helps in preparing educational materials for students.

12- It helps provide learning opportunities for various segments of society.

Despite all the advantages of educational technology that were presented, it has some disadvantages. Ronny Scherera and Timothy Teob. (2019). showed, through studying the technology acceptance model (ATM), that only about 40% of teachers have intentions to accept the use of technology, due to the difficulties that face them in schools. Where technology tools are available. **Ghanem and** Tafida Sayed Ahmed (2011) showed, there is a need for continuous training for teachers in computer science and programming, and the need for technological laboratory equipment such as computer laboratories, multimedia laboratories, and scientific laboratories equipped with digital tools and an electronic library.

Disadvantages of using educational technology

1- The small number of teachers who are proficient in the art of e-learning

2- The high cost of used electronic devices

3- The use of technology is a cause of some negative phenomena such as fraud and infringement of intellectual property rights.

3.Methods of Research and the tools used

From the reference Omar F. G et al. (2020), we chose a geometry unit in the mathematics course for the first year of secondary school, and this unit consists of three lessons that we explain as following

Lesson 1

Division of a line segment

If AB is a directed line segment $\subset \overrightarrow{AB}$, then any point C ϵ $\overrightarrow{AB}$ divides AB into two directed line segment, $\overline{AC}$, $\overline{AB}$, where $\overline{AB}$= $\overline{AC} + \overline{CB}$. If the point C divides $\overline{AB}$ by a given ratio $m_1 : m_2$, and $\overrightarrow{r1}$, $\overrightarrow{r2}$, $\overrightarrow{r}$ are the vectors which are represented by the directed line segments $\overrightarrow{OA}$, $\overrightarrow{OB}$, $\overrightarrow{OC}$ where O is the origin point.

Then

$\frac{AC}{CB}$=$\frac{m_1}{m_2}$ $\therefore m_1 \ \overrightarrow{\mathrm{AC}} = m_2 \overrightarrow{\mathrm{CB}}$

$\therefore m_1 (\vec{C}$-$\vec{A}$)= m_2 ($\vec{B}$-$\vec{C}$)

$\therefore m_1 (\vec{\mathrm{r}} - \overrightarrow{\mathrm{r1}}) = m_2(\overrightarrow{\mathrm{r2}} - \vec{\mathrm{r}})$

$\therefore m_1(\vec{C} - \vec{\mathrm{A}}) = m_2(\vec{\mathrm{B}} - \vec{\mathrm{C}})$ $\therefore m_1\vec{\mathrm{r}} + m_2\vec{\mathrm{r}} = m_1\overrightarrow{\mathrm{r1}} + m_2 \overrightarrow{\mathrm{r2}}$

$\therefore . \vec{r}(m_1 + m_2) = m_1\overrightarrow{r1} + m_2 \overrightarrow{\mathrm{r2}}$

$$\therefore \vec{r} = \frac{m_1\overrightarrow{\mathrm{r1}} + m_2\overrightarrow{\mathrm{r2}}}{m_1 + m_2}$$

Which is called the vector form

Remarks

1- If C $\in \overrightarrow{AB}$: then C divides $\overrightarrow{AB}$ internally : then $\overrightarrow{AC}$ and $\overrightarrow{CB}$ have the same direction and the two values m_1, and m_2 are positive

2-If C $\in \overrightarrow{AB}$: C$\notin \overrightarrow{AB}$ then C divides $\overrightarrow{AB}$ externally then $\overrightarrow{AC}$ and $\overrightarrow{CB}$ have two opposite directions and one of the two values m_1, and m_2, is positive and the other is negative.

If we assume that A = (x_1 , y_1), B = (x_2 , y_2), C = (x, y), then

$\vec{r} = \frac{m_1\overrightarrow{r_1}+m_2\overrightarrow{r_2}}{m_1+m_2}$

$\therefore (x, y) =$

$\frac{m_1(x_1 ,y_1) + m_2(x_2 ,y_2)}{m_1+m2}$=

$\frac{(m_1 \, x_1 + m_2x_2, \ m_1 \, y_1 + m_2y_2)}{m_1+m2}$

$\therefore (x, y) = (\frac{m_1x_1+m_2x_2}{m_1+m_2} , \frac{m_1y_1+m_2y2}{m_1+m_2})$

Which is called the cartesian form. We can use the opposite figure to facilitate finding the cartesian form

Example 1

If A = (1 ,– 4) r B = (6 ,6): find the coordinates of the point C which divides $\overrightarrow{AB}$ internally by the ratio 3 : 2

Solution

C divider $\overrightarrow{AB}$ internally

$\therefore \frac{m_2}{m_1} = \frac{3}{2}$

$$\therefore \vec{r} = \frac{m_1\overrightarrow{r_1} + m_2\overrightarrow{r_2}}{m_1 + m_2}$$

$\therefore \vec{r} = \frac{2(1,-4)+3\ (6,6)}{2+3} =$

$\left(\frac{2\mathrm{x}1+3\mathrm{x}6}{5}, \frac{2\mathrm{x}-4+3\mathrm{x}6}{5}\right)$=(4,2)

Example 2

If A = (2, -3), B = (1 : -1) , find the coordinates of the point C which divides BA externally by the ratio 4 : 3

Solution

C divide, $\overrightarrow{BC}$ externally

$\therefore \frac{m_2}{m_1} = \frac{-4}{3}$

$\therefore \vec{r} = \frac{m_1\vec{r_1}+m_2\vec{r_2}}{m_1+m_2}$

$\therefore \vec{r} = \frac{3(1,-1)+(-4)(2,-3)}{3+(-4)} =$

$\left(\frac{2x1\_4x2}{-1}, \frac{3x-1-4(-3)}{-1}\right)$= (5, -9)

$\therefore C = (5, -9)$

Example 3

If A= (3, -1): B= (5,2) and C∈ $\overleftrightarrow{AB}$ such that 2AC=3CB, find the coordinates of C if

1- the division is internally. 2- the division is externally

Solution

$C = \left(\frac{m_1x_{1+}m_2\,x_2}{m_1+m_2}, \frac{m_1y_{1+}m_2y_2}{m_1+m_2}\right)$

1- $A = (3, -1), \quad B = (5, 2), \quad m_2 : m_1 = 3 : 2$

$\therefore C = \left(\frac{2\times3+3\times5}{2+3}, \frac{2\times-1+3\times2}{2+3}\right) = (\frac{21}{5}, \frac{4}{5})$

$2 - A = (3, \quad -1), \quad B = (5, 2),$

$m_2 : m_1 = 3 : -2$

$\therefore C = \left(\frac{-2\times3+3\times5}{-2+3}, \frac{-2\times-1+3\times2}{-2+3}\right) = (9, 8)$

Remark

To prove that the points A: B and C are collinear r then we prove that:

either $\overrightarrow{AB}$ = k $\overrightarrow{AC}$: k ≠ 0 (using vectors) or the slope of $\overleftrightarrow{AB}$ = the slope of $\overleftrightarrow{AC}$ (using the slope).

or AB = BC + AC (using the distance between two points where AB is the longest length).

If C divides $\overline{AB}$ by the ratio m2 : m1 , then the division is :

1-internally if $\frac{m_2}{m_1}$ *is positive*

2- externally if $\frac{m_2}{m_1}$ *is negative*

Example 4

Prove that the points A= (1, -3), B = (-2, -9), C = (5 ,5) are collinear, then find

1-the ratio by which the point C divides $\overrightarrow{AB}$

2- the ratio by which the point C divides $\overrightarrow{BC}$

sol.

The slope of $\overleftrightarrow{AB}$ =$\frac{-9+3}{-2-1} = 2$

The slope of $\overleftrightarrow{AC}$ =$\frac{5+3}{5-1}$=2

∴A, B, C are collinear

1 – Let C = (5 ,5) divide $\overrightarrow{AB}$ by the ratio m2: m1

$\therefore \frac{m_1-2m_2}{m_1+m_2} = 5 \quad \therefore m_1 - 2m_2 = 5\,m_1 + 5m_2$

$\therefore 4m_1 = -7\,m_2 \quad \therefore \frac{m_2}{m_1} = \frac{-4}{7}$ (negative)

$\therefore$C divides $\overrightarrow{AB}$ by the ratio 4 :7 externally

$2 - \text{Let A}$

$= (1, -3)$divide $\overrightarrow{BC}$ by the ratio m2: m1

$$\therefore \frac{-2m_1 + 5m_2}{m_1 + m_2} = 1$$

$$\therefore -2\, m_1 + 5\, m_2 = m_1 + m_2$$

$\therefore 3m_1 = 4m_2 \quad \therefore \frac{m_2}{m_1} = \frac{3}{4}$ $(positive)$

$\therefore$C divides $\overrightarrow{BC}$ by the ratio 3 :4 internally

Activities for lesson 1

mailto:https://www.allmath.com/points-coordinates.php

In this activity, the problems for this lesson are solved as follows:

First, we enter the data of the problem in the boxes provided, then specify the type of problem according to what is required in the question internally or externally. After entering each number in its correct place and choosing the type of problem, the "Calculate" button is pressed, and the program begins processing that data and showing the final answer. The program also allows solving the problem in detailed steps, as it writes the data that was entered in the boxes from the beginning, then writes the solution equation or the law used in the solution (Formula), then substitutes the numbers into this equation, and it is solved in detail in steps (Steps) and the result is shown. Final answer

Example 5

If A = (1, - 4), B = (6 ,6): find the coordinates of the point C which divides $\overrightarrow{AB}$ internally by the ratio 3:2.

Here in this problem it is required to find the coordinates of point C that divides the straight line AB internally.

First: The student will identify the data in the problem, as $r_1 = (1, -4),\ r_2 = (6, 6),$ $ratio = 3:2$

Second: The student will enter each number in the box specified for him, since from the given r_1 we conclude that $X_1 = 1,\ Y_1 = -4$, from the given r_2 , and from the ratio m=3, n=2, we deduce that $X_2 = 6,\ Y_2 = 6$.

Third: The student chooses the type of question, whether internally or externally, according to what is required in the question, and here in the question it is (internally).

Fourth: The student clicks on the Calculate button to calculate the result.

Fifth: Here comes the role of the program, as the program will process that input data and show the final result to solve the problem in addition to writing the data again (Data), writing the equation used in the solution (Formula), and showing the steps (Steps) in detail to the student. Finally, the final answer is shown again.

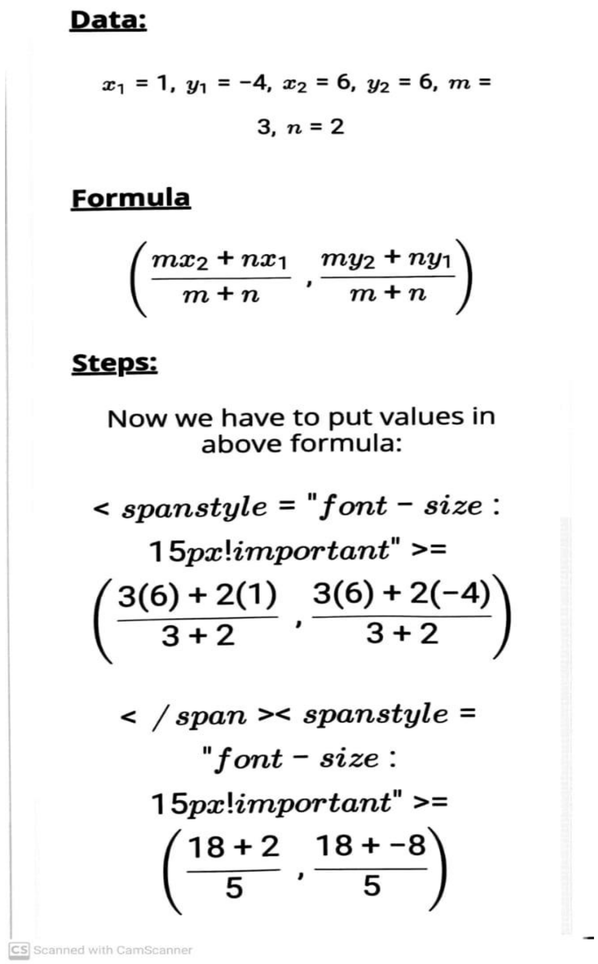

Figure (1): Step (1) for example 5

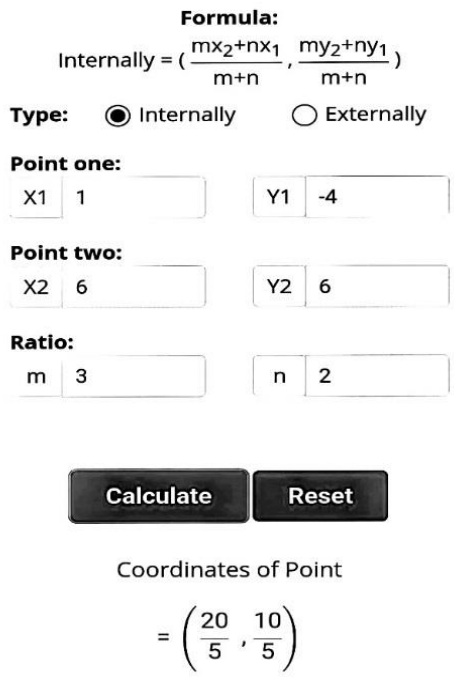

Figure (2): Step (2) for example 5

Example 6

If A (2 ,5), B (7, – 1): then the point C which divides $\overrightarrow{AB}$ externally in the ratio 3:2 is ......'...."..

First: The student will identify the data in the problem, as $r_1 = (2,5),\ r_2 = (7,-1)$, $ratio\ = 3:2$

Second: The student will enter each number in the box specified for him, since from the given r_1 we conclude that $X_1 = 2,\ Y_1 = 5$, from the given r_2 , and from the ratio m=3, n=2, we deduce that $X_2 = 7,\ Y_2 = -1$.

Third: The student chooses the type of question, whether internally or externally, according to what is required in the question, and here in the question it is (externally).

Fourth: The student clicks on the Calculate button to calculate the result.

Fifth: Here comes the role of the program, as the program will process that input data and show the final result to solve the problem in addition to writing the data again (Data), writing the equation used in the solution (Formula), and showing the steps (Steps) in detail to the student. Finally, the final answer is shown again.

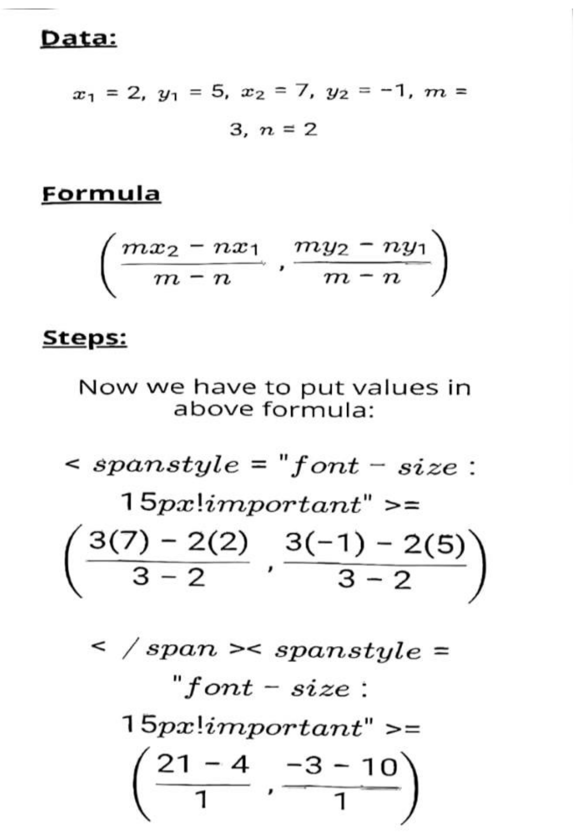

Figure (3): Step (1) for example 6

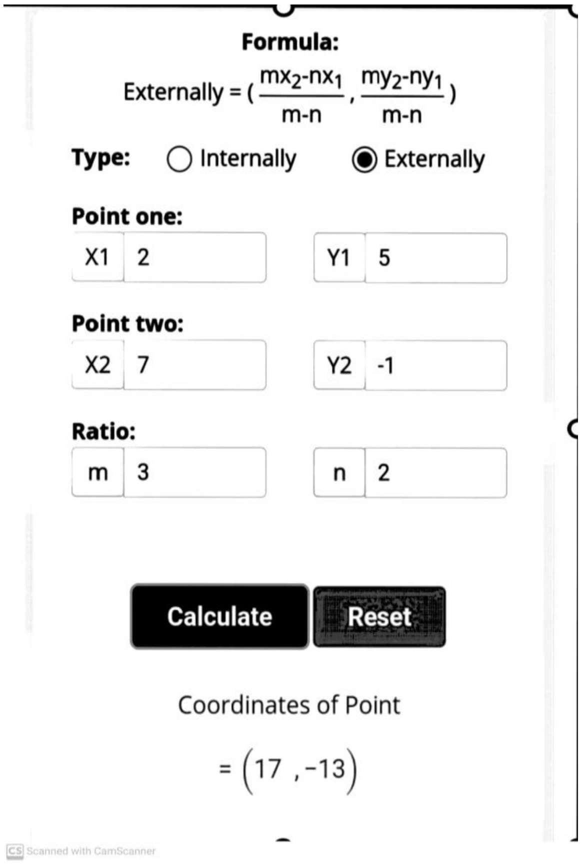

Figure (4): Step (2) for example 6

Kahoot!

This application has several characteristics and advantages, and it is one of the easy and distinctive applications to use in the classroom and online lectures, as it draws the student's attention and makes him more focused on the lecture and the lesson being presented, and even increases the student's enthusiasm for the lesson and the spirit of competition between him and his colleagues. The application contains sample questions in the form of games for almost all subjects and for all educational levels. The application has more than one interface, so that the teacher and the student can each use it in the way that suits him. In our current lesson, we will show how the student uses this application to solve questions.

First: The student opens the link sent by the teacher, and this page appears to him, asking him to enter the game code. This code is only available with the game designer, who is the teacher as shown in Figure (5).

Figure (5): Step (1) for the above application

Second: The application asks the student to enter a nickname, as shown in Figure (6)

Figure (6): Step (2) for the above application

Third: The question appears and below it is are four options from which the student chooses the correct answer. Each question has a specific time. The time for the question is determined and chosen by the teacher. After the student chooses the correct answer, it appears to him as in the picture and appears to him in green, and the word is written directly under the question for him. If the student chooses an incorrect answer, it will be in dark red and the application will also show him the answer, as shown in Figure (7)

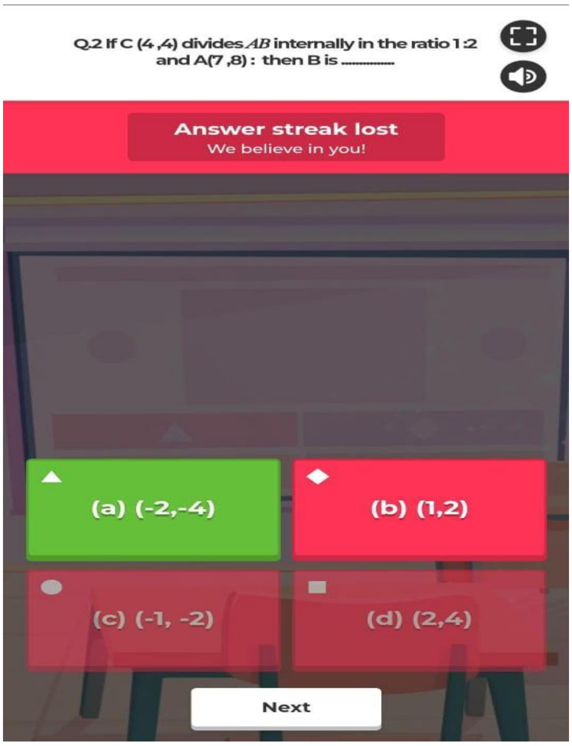

Figure (7): Step (3) for the above application

Finally, after the student finishes solving all the questions, his results are shown to him in the form of centres, where there are three positions: first place, second place, and third place. The student's ranking in each centre is according to the points he collected, so the student with the most points is in first place, followed by the second student, then third, as shown in Figure (8).

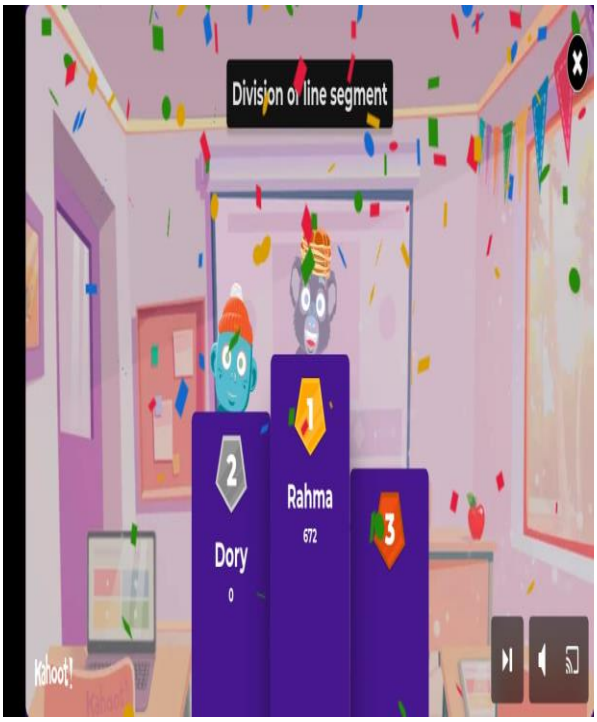

Figure (8): Step (4) for the above application

Exam

Choose the correct answer from those given

Q1 - If A= (3 t6), B= (-l ,4), then the midpoint of $\overline{AB} = \cdots , \cdots$

(a) (−4,10) (b) (−4,5) (c) (5 , 1) (d) (−2,5)

Q2 - If A (2 ,5), B (7, - 1): then the point C which divides $\overline{AB}$ externally in the ratio 3: 2 is ......'...."..

(a) (−25, −7) (b) (25,7) (c) (17 , 13) (d) (17, −13)

Q3 - If A= (−4 ,4), B= (5, −8), C∈ $\overline{AB}$ such that CB:AC=l:2 then C =…………

(a) (4, −8) (b) (2,−4) (c) (−8 , 4) (d) (−4,2)

Q4 - If C∈ $\overline{AB}$, AB = 4 BC and A (−1, 4): B (3, 4): then the point C is …………

(a) (0,4) (b) (4,2) (c) (4 , 0) (d) (2,4)

Q5 - If A (2,3), B (6, −l) then the point C which lies at quarter the distance from A to B is……………

(a) (2,3) (b) (2,−3) (c) (3, 2) (d) (−3,2)

Q6 - If C (4 ,4) divides $\overline{AB}$ internally in the ratio 1 :2 and A (7 ,8) , then B is ....

(a) (−2, −4) (b) (1,2) (c) (−1, −2) (d) (2,4)

Q7 - If $\overrightarrow{AB}$ = (3,4), A(− 2,5): C divides $\overline{AB}$ by the ratio 3:2 externally , then C =…………

(a) (7,17) (b) (8,3) (c) (−8 , 3) (d) (−7,−17)

Q8 -The ratio of division that the X-axis divides the line segment $\overline{AB}$ where A (2;5), B(7 ,−2) is……………

(a) 5: 2 internally (b) 2 :3 internally.

(c) 3 :2 externally (d) 2 :5 externally.

Q9- If C is the midpoint of $\overline{AB}$ and D divides $\overline{AC}$ internally by ratio 2:3, then D divides $\overline{AB}$ by ratio ....

(a) 1: 2 (b) 2 : 5 (c) 1: 4 (d) 1: 8

Q10- If A (− 3, −7), B (4, 0), then the point C which divides $\overline{AB}$ internally in the ratio 5: 2 is ....'...

(a) (−2,2) (b) (2,−2) (c) (2 , 2) (d) (−2,−2)

Lesson 2

Equations of the Straight Line

The general form of the equation of the straight line is $a\,x + by + c = 0$ where a, b, c are real numbers, a and b are not equal to zero together. This equation is represented by a straight line, for example the relations: x+ y=6, y=3, x-4=0 represent straight lines, but the relations: $y + \sqrt{x} = 4$, x+$\frac{1}{y} = 5$ do not represent straight lines.

The slope of the straight line

1-If the straight line L passes through the two points $(x_1, y_1), (x_2, y_2)$ then m (the slope of the straight line) = Difference between y coordinate/ Difference between X-coordinate, for example

the straight line which passes through the two points (1,3), (4,2) its slope equals $\frac{2-3}{4-1}$=- $\frac{1}{3}$

2-If the equation of the straight line is in the form $a\,x + by + c = 0$ then the slope of the straight line = -The coefficient of X / The coefficient of y, for example the straight line whose equation is: 5X+2y+7=0, its slope =$\frac{-5}{2}$

3-If the equation of the straight line is in the form y = m x + c then its slope = m and intercepts from y-axis apart of length = the absolute value of the number c and it passes through the point (0 , c), for example the straight line whose equation is : y- 3 x- 5 ,its slope= 3 and intercepts from the negative part of y-axis

4- length units and it passes through the point (0 , - 5) 4 If g is the measure of the positive angle r which the straight line makes with the positive direction of X-axis : then the slope of the straight line = $tan\ 0^o$

5-If g is the measure of the positive angle r which the straight line makes with the positive direction of X-axis: then the slope of the straight line = $tan\ 0^o$

6-The slope of X-axis and the slope of any horizontal straight line (parallel to X-axis) are equal to zero. The slope of y-axis and the slope of any vertical straight line (parallel to y-axis) are undefined.

The relation between the two parallel straight lines and the perpendicular straight lines

If L1 and L2 are two straight lines of slopes m, and respectively, then:

1- $L_1 // L_2$ then $m_1 = m_2$

i. g. two parallel straight lines have equal slopes and vice versa.

2- L_1 Intersect L_2 , then $m_1 m_2 = -1$ (unless one of them is parallel to one of the two coordinate axes)

i.e. the product of the slopes of any two perpendicular straight lines = – 1 and vice versa., for example If the straight line L, passes through the two points (3 ,5) , (– 3 ,– 1) : then its slope $m_1 = \frac{5+1}{3+3} = 1$ and the straight line L_2 whose equation is 3 x– 3 y + 5 = 0 its slope m_2, where the straight line L, makes with the positive direction of X-axis a positive angle of measure 135^o, its slope

$m_3 = tan\, 135^o = -1$

$m_1 = m_2$ $\quad L_1 // L_2$

$m_1 m_2 = -1$ $\quad L_1$ *perpendicular to* L_2

$m_2 m_3 = -1$ $\quad L_2$ perpendicular to L_3

Direction vector of any straight line

Every non-zero vector can be represented by a directed line segment on a straight line is called a direction vector of this straight line.

ln the opposite figure: Each of $\overrightarrow{XY}, \overrightarrow{YZ}, \overrightarrow{ZX}, \overrightarrow{YX}$ is a direction vector to the straight line L if $\vec{u} \neq 0$,u straight line L : then, u direction vector to the straight line L

$\vec{u}$= (a, b) a direction vector to a straight line, then k$\vec{u}$ is a direction vector to the same straight line, where k ∈ R*

for example $\vec{u}$= (3,4) is a direction vector of a straight line, then each of the vectors (6,8), (-3,-4) , (1.5,2) ,(15,20) a direction vector of this straight line, For example if (2,-3) is a direction vector of a straight line then the slope of this straight line = -3/2 and the straight line whose slope =$-4/7$ then the vector $\vec{u}$= (7,-4) is a direction 7 to it.

The different forms of the equation of the straight line

$(y - y_1)/(x - x_1)$ form is called the cartesian equation of the straight line

Example 7

Find the different forms of the equation of the straight line which passes through the point A= (3, -2) and $\vec{u}$ = (-2,1) is a direction vector of it.

Solution

The vector equation of the straight line is: r vector = (x, y) = (3, -2)+k(-2,1)

The two parametric equations of the straight line ate: x=3-2k, y=-2+k

The cartesian equation is: $\frac{y+2}{x-3} = -\frac{1}{2}$,

x-3=-2y-4

The equation of the straight line given two points lying on it P (x_1, y_1), **N**(x_2, y_2)

The cartesian form is $\frac{y-y_1}{x-x_1} = \frac{y_2-y_1}{x_2-x_1}$,

Example 8

Find the different forms of the equation of the straight line which passes through the two points

P= (3, -1), N= (-2,4)

Solution

$\vec{u} = \vec{N} - \vec{P} = (-5,5)$,$\overrightarrow{u'} = \frac{1}{5}\vec{u}$, $\vec{u} = (-1,1)$

Slope of the straight line = -1

$\vec{r} = (3,-1) + k(-1,1)$,

$$(x,y) = (3,-1) + k(-1,1)$$

Two parametric equation are x=3-k , y= -1+k

Cartesian equation is $\frac{y+1}{x-3} = -1$,

The equation of the straight line given its slope and the intercepted part from y-axis

The straight line has a slope m and intersects the y-axis at the point (0, c), i.e. intercepts from y-axis a part of length = the absolute value of the number c then by substituting in the cartesian form we find that $\frac{y-c}{x-0} = m$

i.e. y=m x + c

The equation of the straight line given the two intercepted parts from the two coordinate axes

Let the straight line intersect X-axis at the point (a,0) and y-axis at the point (0, b).

The slope of the straight line m =$\frac{b-0}{0-a}$=$\frac{-b}{a}$

Substituting in the cartesian form $\frac{y-0}{x-a}$=$\frac{-b}{a}$

then $\frac{x}{a} + \frac{y}{b} = 1$

Example 9

Find the general form of the equation of each of the following:

1-The straight line L_1 whose slope = 3 and intercepts from the negative part of y-axis a part = 7 length units.

2-The straight line L_2 which intercepts from the positive part of X-axis 4 length units and from the negative part of y-axis 3 length units.

Solution

1- The equation of the straight line L_1 is:

y = m x + c, y=3x-7

2-The equation of the straight line L_2 is:

$\frac{x}{a}$ + $\frac{y}{-3}$=1, 3x-4y-12=0

Activities for lesson 2

In this activity, the basic concepts of the straight line will be presented in several steps that we will explain as follows

1– General from of straight line

https://www.nagwa.com/en/videos/615141929374/

An illustrative of the general form of straight line is presented through its algebraic solution and its graphical application, as shown in figure (9)

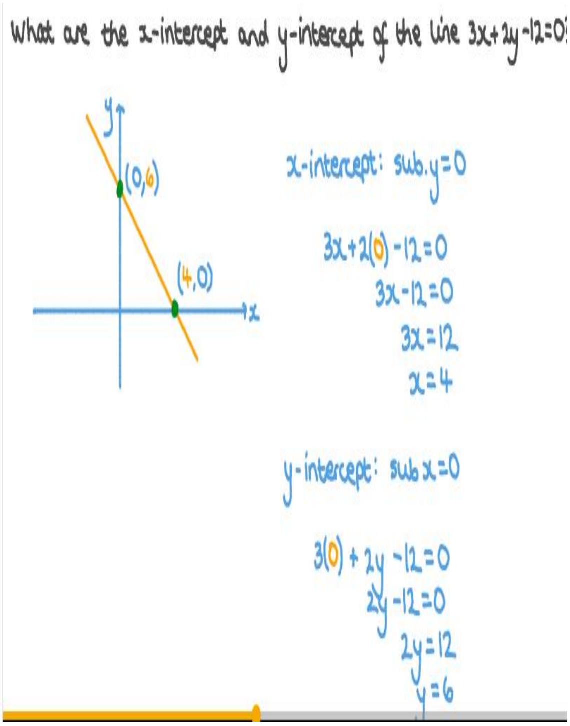

Figure (9): general form of straight line

The slope of the straight line

https://www.mathsisfun.com/calculus/slope-function-point.html

Through this activity, the shape of the slope is determined and clarified by setting the required equation and its graph form is shown, and the differences in the slope are clarified and explained by moving the orange line, which is the line explaining the slope.

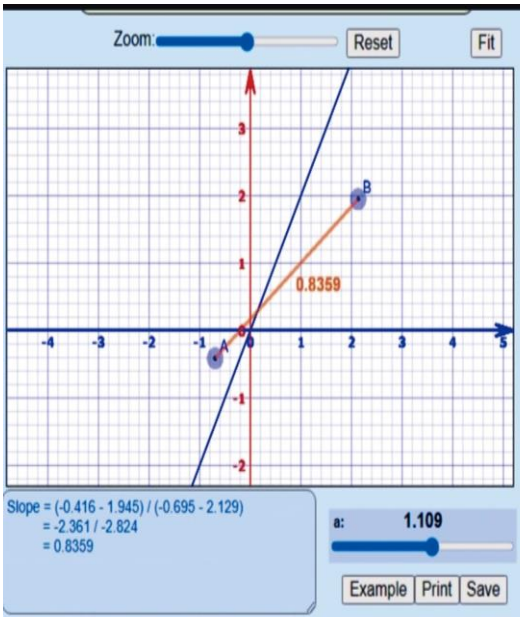

Figure (10): the slope straight line

Parallel, perpendicular lines and their slope

https://www.mathwarehouse.com/algebra/linear_equation/parallel-perpendicular-lines-applet.php

The required points are inserted, and when the slop appears, we notice that the slope of the first line is equal to the slope of the second line, and we conclude that the two lines are parallel

slope1: $\frac{Rise}{Run} = \frac{y_2-y_1}{x_2-x_1} = \frac{3-2}{2-1} = \frac{1}{3}$

slope2: $\frac{Rise}{Run} = \frac{1}{3}$

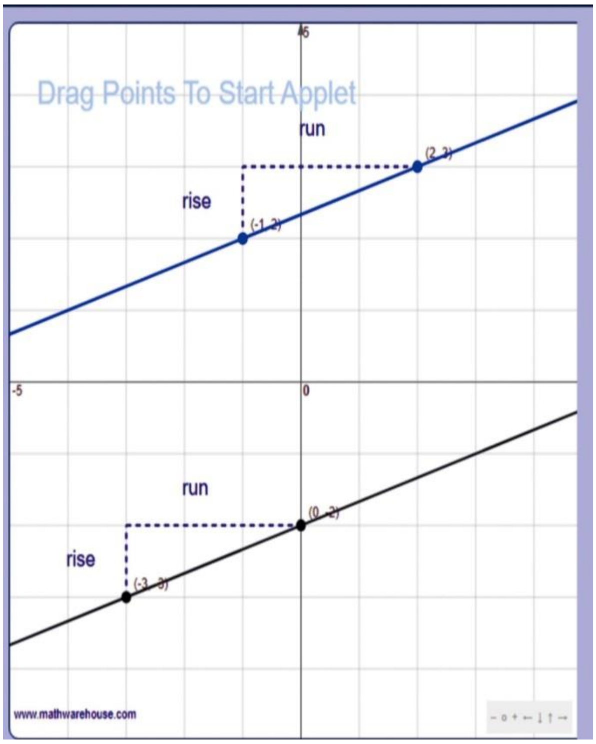

Figure (11): the parallel of the straight lines

parallel and perpendicular lines

Slope1 and 2: $\frac{Rise}{Run} = \frac{1}{3}$ (parallel lines)

Slope3: $\frac{Rise}{Run} = \frac{3}{-1} = -3$ (perpendicular line)

When adding points to a third line, we notice that the slope of the third line is the inverse of the multiplicative opposite sign of the slope of the two parallel lines and is perpendicular to them.

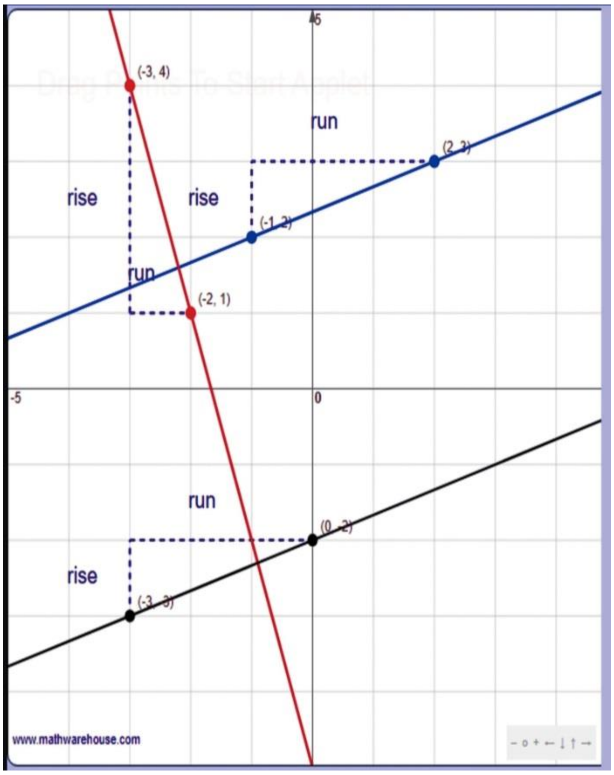

Figure (12): parallel and perpendicular lines

Direction vector and slope of straight line

Through the following figures (11,12) we show that the slope does not change by changing the direction vector, the slope has not changed and the slope can be measured by the direction vector. It is clear that direction vector =(1,2), Slope=2/1=2 , also direction vector =(2,4), Slope=4/2=2,

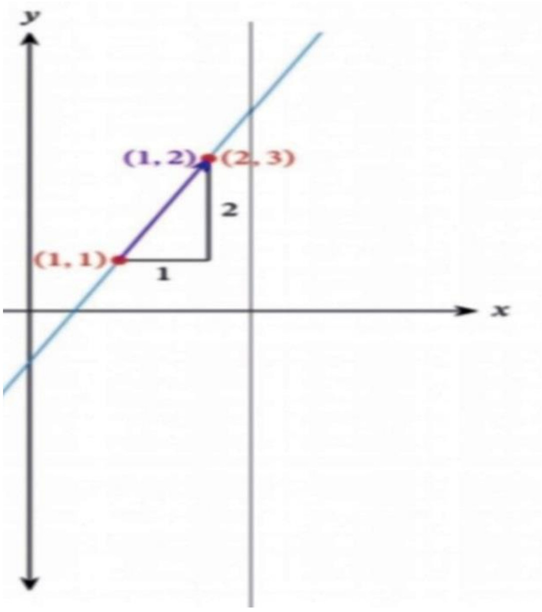

Figure (13): direction vector

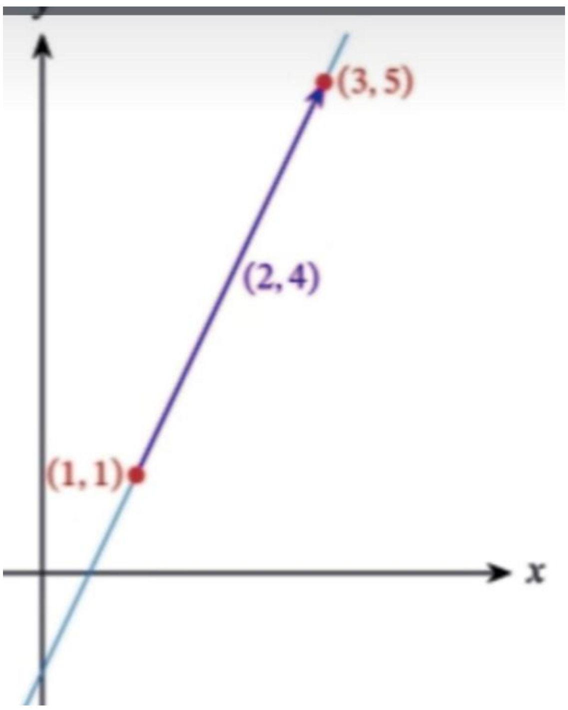

Figure (14): direction vector

Different forms of straight line

https://demonstrations.wolfram.com/LinesIn3DSpaceParametricVectorAndCartesianForms/

Parametric form

We explain the form of equations algebraically and graphically by choosing the type of equation and specifying the values of the variables, as in the first figure the Parametric form is displayed. On the following figure $x = a + bt$, $y = c + dt$, $z = e + ft$, the shape is represented graphically in a three-dimensional plane to represent the X,Y,Z axis

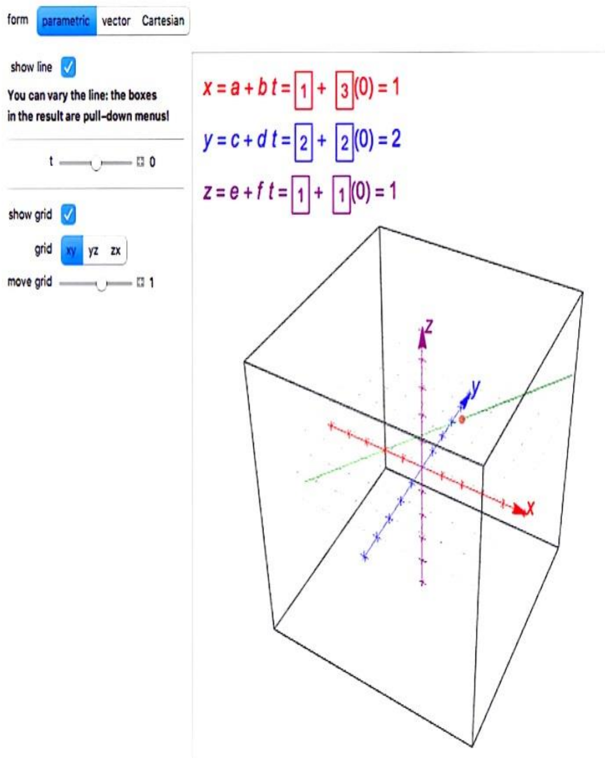

Figure (15): Parametric form

Vector form

In the following figure, the vector form is displayed by entering the coordinate values x, y, z, and the form is represented graphically in a three-dimensional plane.

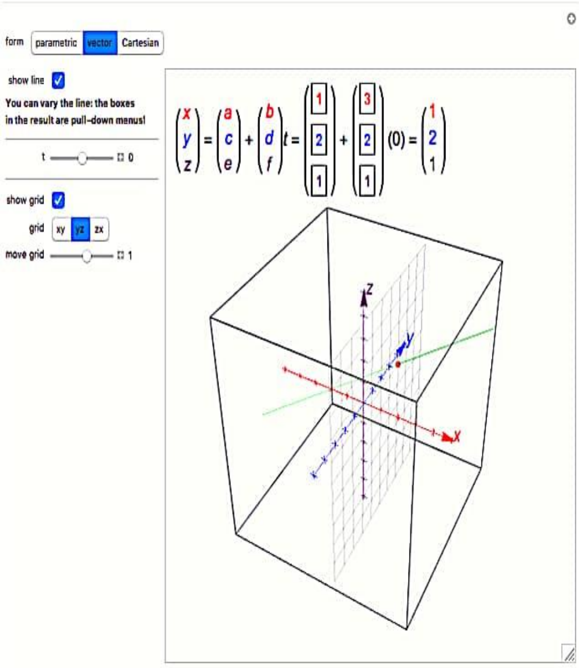

Figure (16): vector form

Cartesian form

In the following figure, the Cartesian form is displayed as X-X1/a, Y-Y1/b, Z-Z1/c, and the form is represented graphically in a three-dimensional plane.

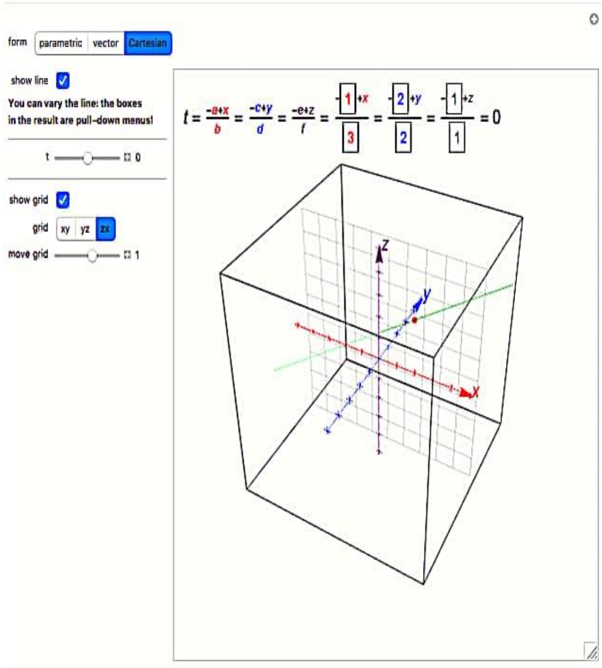

Figure (17): Cartesian form

Exam:

Q1 - The straight line which passes through the two points (1,3), (4,2) its slope equals

a) -1/2 b) 3 c) 2/3

Q2 -The straight line which passes through the two points (1,3), (4,2) its slope equals

a) 2/5 b) -5/2 c) 3/5

Q3- IF (2, -3) is a direction vector of a straight line then the slope of this straight line

a) 3/2 b) 1/2 c) -3/2

Q4- the straight line whose slope = -4/7 then the vector

a) (7, -4) b) (7,4) c) (-7,4)

Q5- Find the cartesian equation of the straight line which passes through the point A=(3,-2) and B=(-2,1) is a direction vector of it.

a) x-2y+1 b) x+2y+1 c) x-2y-1

Q6- Find the two parametric equation of the straight line which passes through the two points P= (3, -1), N= (-2, 4)

a) x=3-k, y=-1+k b) x=3+k, y=1+k

c) x=-3+k, y=1-k

Q6- Find the general form of the equation of the straight line L1 whose slope = 3 and intercepts from the negative part of y-axis a part = 7 length units. of each of the

a) y=7x-3 b) y=3x-7 c) y=x+7

Lesson 3

Measure of the angle between two straight lines

If two straight lines intersect, then there will be two angles (each of them supplements the other), they are either two right angles or one of them is an acute angle and the other is an obtuse angle. If θ is the measure of the included angle between the two straight lines L_1 and L_2 whose slopes are $m_1 \; and \; m_2$,then

$\tan\theta = \left|\frac{m_1 - m_2}{1+ m_1 m_2}\right|$, where $\theta \in \left[0 , \frac{\pi}{2}\right]$

, $m_1 = \tan\theta_1$ and $m_2 = \tan\theta_2$

With noticing the following:

1- If the tangent is positive, then we obtain an acute angle.

2-If the tangent is zero, then the measure of the included angle is zero then $m_1 = m_2$, and the two straight lines are parallel or coincident.

3-If the tangent is undefined, then the measure of the included angle is 90° then $m_1 m_2 = -1$ and the two straight lines are orthogonal (perpendicular)

4-The measure of the obtuse angle = the measure of the supplementary angle of the acute angle.

Example 10

Find the measure of the acute angle between the two straight lines: $L_1: x - 2y + 5 = 0$, $L_2: 2x + 4y - 7 = 0$.

Solution

$\because \; m_1 = \frac{1}{2} , m_2 = \frac{-2}{4} = \frac{-1}{2}$

$\therefore \tan\theta = \left|\frac{m_1 - m_2}{1+ m_1 m_2}\right| = \left|\frac{\frac{1}{2}+\frac{1}{2}}{1+\left(\frac{1}{2}\right)\left(\frac{-1}{2}\right)}\right| = \frac{4}{3}$

$\therefore \theta \approx 53° \, 8'$

Example 11

Find the measure of the acute angle between the two straight lines:

$L_1: \vec{r} = (2,3) + k(4,3)$, $L_2: \vec{r} = (1,6) + k'(7,-1)$

Solution

$\because\ m_1 = \frac{3}{4}, m_2 = \frac{-1}{7}$

$\therefore \tan\theta = \left|\frac{m_1 - m_2}{1 + m_1 m_2}\right| = \left|\frac{\frac{3}{4} + \frac{1}{7}}{1 + \left(\frac{3}{4}\right)\left(\frac{-1}{7}\right)}\right| = 1$

$\therefore \theta = 45°$

Example 12

If the measure of the angle between the two straight lines:

$L_1: x - 2y + 1 = 0$, $L_2: x + ky + 2 = 0$

equals $45°$, find the value of k

Solution

$\because\ m_1 = \frac{1}{2}, m_2 = \frac{-1}{k}\ ,\ \theta = 45°$

$\therefore \tan 45° = \left|\frac{\frac{1}{2} + \frac{1}{k}}{1 - \frac{1}{2k}}\right| \qquad \therefore\ 1 = \left|\frac{\frac{1}{2} + \frac{1}{k}}{1 - \frac{1}{2k}}\right|$

$\therefore \frac{\frac{1}{2} + \frac{1}{k}}{1 - \frac{1}{2k}} = \pm 1$

$\therefore$ either $\frac{1}{2} + \frac{1}{k} = 1 - \frac{1}{2k}$

$\therefore \frac{3}{2k} = \frac{1}{2} \qquad \therefore k = 3$

$or \quad \frac{1}{2} + \frac{1}{k} = \frac{1}{2k} - 1$

$\therefore \frac{1}{2k} = \frac{-3}{2} \qquad \therefore k = \frac{1}{3}$

Example 13

Find the measures of the angles of Δ ABC, whose vertices are $A = (6,5)$, $B = (6,1)$ and $C = (3,1)$

Solution

$\because$ The slope of $\overleftrightarrow{AB} = \frac{5-1}{6-6} = \frac{4}{0}$ (undefined)

$\because \overleftrightarrow{AB} \parallel\ y\_axis$ (1)

$\because$ The slope of $\overleftrightarrow{BC} = \frac{1-1}{6-3} = \frac{0}{3} = zero$

$\therefore \overleftrightarrow{BC} \parallel x\_axis$ (2)

$\because$ The slope of $\overleftrightarrow{AC} = \frac{5-1}{6-3} = \frac{4}{3}$ (3)

From (1) and (2) : $\therefore m(\angle B) = 90°$

$\therefore\ \angle A\ and\ \angle C$ are acute angles

From (2) and (3): $\therefore \tan C = \left|\frac{\frac{4}{3} - zero}{1 + zero \times \frac{4}{3}}\right| = \frac{4}{3}$

$\therefore m(\angle C) \approx 53°\, 8'$

$\therefore m(\angle A) = 180° - (53°\, 8' + 90°)$

$= 36°\, 52'$

Remarks:

To determine the type of the triangle ABC according to the measures of its angles (where AC represents the length of the greatest side in the triangle):

1-If $(AC)^2 > (AB)^2 + (BC)^2$, then the triangle is an obtuse-angled triangle at B

2-If $(AC)^2 = (AB)^2 + (BC)^2$, then the triangle is a right-angled triangle at B

3-If $(AC)^2 < (AB)^2 + (BC)^2$, then the triangle is an acute-angle triangle at B

Example 14

Find the measures of the angles of the triangle whose vertices are $= (4,3), B = (-1,1) and$ $C = (-6,4)$, then find its area.

Solution

$\because$ AB $= \sqrt{(4+1)^2 + (3-1)^2} = \sqrt{29}$ length units.

BC $= \sqrt{(-1+6)^2 + (1-4)^2} = \sqrt{34}$ length units.

AC $= \sqrt{(4+6)^2 + (3-4)^2} = \sqrt{101}$ length units.

$\therefore (AC)^2 > (AB)^2 + (BC)^2$

$\therefore \Delta ABC$ is an obtuse-angled triangle at B

$\therefore \angle A \; and \; \angle C$ are acute angles

$\because$ The slope of $\overleftrightarrow{AB} = \frac{3-1}{4+1} = \frac{2}{5}$

, the slope of $\overleftrightarrow{BC} = \frac{1-4}{-1+6} = \frac{-3}{5}$

, and the slope of $\overleftrightarrow{AC} = \frac{3-4}{4+6} = \frac{-1}{10}$

$\therefore \tan A = \left|\frac{\frac{2}{5}+\frac{1}{10}}{1-\frac{2}{50}}\right| = \frac{25}{48}$ $\quad \therefore m(\angle A) \approx 28°$

, $\tan C = \left|\frac{\frac{-3}{5}+\frac{1}{10}}{1+\frac{3}{50}}\right| = \frac{25}{53}$ $\quad \therefore m(\angle C) \approx 25°$

$\therefore m(\angle B) = 180° - (28° + 25°) = 127°$

, the area of the triangle = $\frac{1}{2} \times$ the product of two side lengths $\times$ sine of the included angle between them

$= \frac{1}{2} \times AB \times AC \times \sin A$

$= \frac{1}{2} \times \sqrt{29} \times \sqrt{101} \times \sin 28°$

≈ 12.7 square units.

Activities for lesson 3

https://www.cuemath.com/geometry/angle/-between-two-lines

In this activity, the lesson can be explained in an easy and simple way, and the mathematical laws present in the lesson can be clarified and interpreted, for example we can use the activity to show how to find the angle between two lines $L_1: a_1x + b_1y + c_1 = 0$, $L_2: a_2x + b_2y + c_2 = 0$, using the law $\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1m_2}\right|$, where m_1, m_2 are the slope of L_1, L_2 respectively with explaining this by drawing as showing in the following screenshot.

How to Find Angle Between Two Lines?

The angle between two lines can be calculated by knowing the slopes of the two lines, or by knowing the equations of the two lines. The angle between two lines generally gives the acute angle between the two lines.

The angle between two lines can be computed from the slope of the two lines, and by using the trigonometric tangent function. Let us consider two lines with slopes m_1, and m_2 respectively. The acute angle θ between the lines can be calculated using the formula of the tangent function. The acute angle between the two lines is given by the following formula

$$\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1 m_2}\right|$$

Further, we can find the angle between the two lines if the equations of the two lines are given. Let the equations of the two lines be

$l_1 = a_1x + b_1y + c_1 = 0$, and $l_2 = a_2x + b_2y + c_2 = 0$.

The angle between the two lines can be computed by the tangent of the angle between the two lines.

$$\tan\theta = \left|\frac{a_2b_1 - a_1b_2}{a_1a_2 + b_1b_2}\right|$$

Angle Between Two Lines

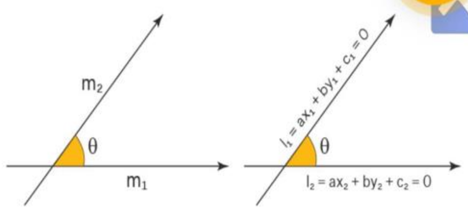

Figure (18): how to find angle between two lines

Example 15

given the slopes of two lines are

$m_1 = 1\,, m_2 = \frac{1}{2}$, using the low

$\tan\theta = \left|\frac{m_1 - m_2}{1+ m_1 m_2}\right|$, we can explanation by

the activity $\tan\theta = \left|\frac{m_1 - m_2}{1+ m_1 m_2}\right| = \left|\frac{1-\frac{1}{2}}{1+1\times\frac{1}{2}}\right| = \frac{1}{3}$

$\Rightarrow \quad \theta = \tan^{-1}\left(\frac{1}{3}\right) = 18.43^{\circ}$, in the second

Examples on Angle Between Two Lines

Example 1: Find the angle between two lines having slopes of 1, and 1/2 respectively.

Solution:

The gives slopes of the two lines are $m_1 = 1$ and $m_2 = 1/2$.

The formula to find the angle between the two lines is $\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1m_2}\right|$.

$\tan\theta = \left|\frac{1-1/2}{1+1/2 \cdot 1}\right|$

$\tan\theta = \left|\frac{1/2}{3/2}\right|$

$\theta = \left|\tan^{-1}\frac{1}{3}\right|$

Answer: ∴ The angle between the lines is $\tan^{-1}\left(\frac{1}{3}\right)$.

Figure (19): solution for example 15 by the above activity.

Also, in this activity, we can find questions to measure students' understanding of the lesson. For example, in the first question, we find the angle between two parallel lines, and the correct answer will be 0, in the second question, we find that the slope of x-axis equals 0, and the slope of the second line equals 1. Substituting into the law, we find that $\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1 m_2}\right| = \left|\frac{0-1}{1+0\times 1}\right| = 1 \Rightarrow \theta = \tan^{-1}(1) = 45^{\circ}$.

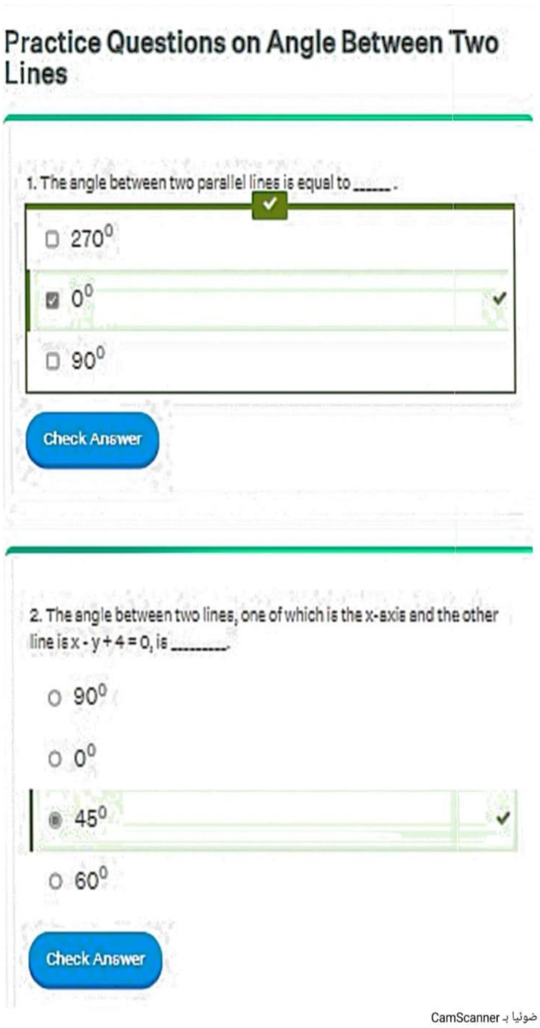

Figure (20): measure students' understanding of the lesson by the above activity.

https://wordwall.net/play/66033/579/356

This activity is a variety of exercises in the lesson to measure the extent of the students' understanding of the lesson, attract their attention, and compete with them for the solution. This activity is a celebration in which the student chooses a card from the cards shown in a random manner, to be shown a random question that the student solves.

Figure (21): choose a random question by the above activity.

Exercise 1

You are required to find the measure of the acute angle between two lines whose slope is $m_1 = \frac{1}{2}$, $m_2 = \frac{2}{9}$, where the student is compensated in law

$$\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1 m_2}\right| = \left|\frac{\frac{1}{2}-\frac{2}{9}}{1+\frac{1}{2}\times\frac{2}{9}}\right| = \frac{1}{4}$$

$$\Rightarrow \quad \theta = \tan^{-1}\left(\frac{1}{4}\right) = 14^{\circ}$$

The student makes a choice °14.

Figure (22): **solution for exercise 1** .

Exercise 2

You are given two straight lines $L_1: y - \sqrt{3}\,x - 5 = 0$ $, L_2: x - \sqrt{3}\,y - 6 = 0$ and you are asked to find the angle between them, the student calculates the slope of the first and second straight lines $m_1 = \sqrt{3}$ $, m_2 = \frac{1}{\sqrt{3}}$, then he calculates the angle between the two straight lines $\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1 m_2}\right| = \left|\frac{\sqrt{3} - \frac{1}{\sqrt{3}}}{1 + \sqrt{3} \times \frac{1}{\sqrt{3}}}\right| = \frac{\sqrt{3}}{3} \Rightarrow \theta = \tan^{-1}\left(\frac{\sqrt{3}}{3}\right) = 30^{\circ}$

Figure (23): **solution for exercise 2** .

Exercise 3

You are given two straight lines $L_1: x/a + y/b = 1$, $L_2: x/a - y/b = 1$ and you are asked to find the angle between them, the student calculates the slope of the first and second straight lines $m_1 = \frac{-b}{a}$ $, m_2 = \frac{b}{a}$, then he calculates the angle between the two straight lines $\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1 m_2}\right| = \left|\frac{\frac{-b}{a} - \frac{b}{a}}{1 - \frac{b}{a} \times \frac{b}{a}}\right| = \left|\frac{\frac{-2b}{a}}{1 - \frac{b^2}{a^2}}\right| = \left|\frac{-2ab}{a^2 - b^2}\right| \Rightarrow \theta = \tan^{-1}\left(\frac{2ab}{a^2 - b^2}\right)$

then the answer is D

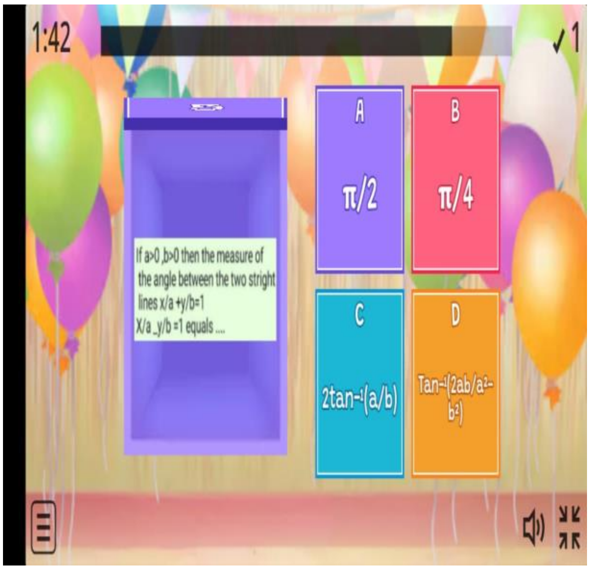

Figure (24): solution for exercise 3 .

Exercise 4

You are given two straight lines $L_1: \vec{r} = (0,2) + k(3,1)$,
$L_2: \vec{r} = (0,5) + k(2,1)$, and you are asked to find the angle between them, the student calculates the slope of the first and second straight lines $m_1 = \frac{-1}{3}$, $m_2 = \frac{1}{2}$, then he calculates the angle between the two straight lines $\tan\theta = \left|\frac{m_1 - m_2}{1+m_1 m_2}\right| = \left|\frac{\frac{-1}{3} - \frac{1}{2}}{1+\frac{-1}{3}\times\frac{1}{2}}\right| = 1 \Rightarrow$

$\theta = \tan^{-1}(1) = 45^{\circ}$

Figure (25): solution for exercise 4

Exercise 5

You are given the slope of the first and second straight lines $m_1 = 2$, $m_2 = \frac{-1}{2}$ and you are asked to find the angle between them, the student calculates the angle between the two straight lines $\tan\theta = \left|\frac{m_1 - m_2}{1+m_1 m_2}\right| = \left|\frac{2+\frac{1}{2}}{1+2\times\frac{-1}{2}}\right| = \frac{5}{0}$ (unidentified) $\Rightarrow \theta = 90^{\circ}$

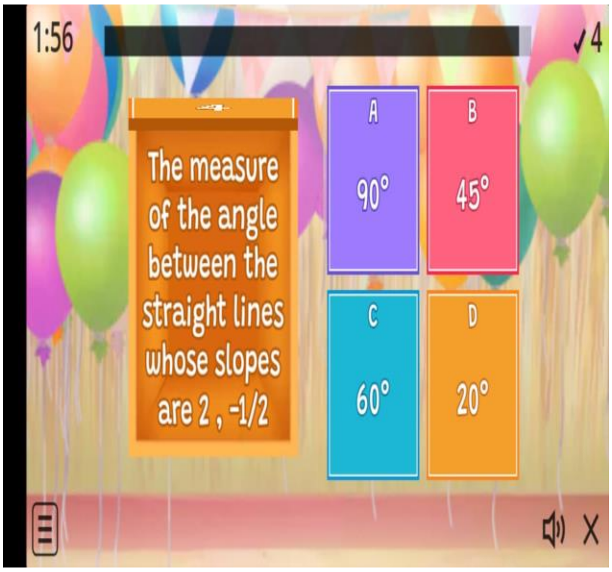

Figure (26): solution for exercise 5

Quiz

I-Choose the correct answer

1-The measure of the acute angle between the straight line $x - 2y + 3 = 0$ and the straight line passing through two points (4, -1) , (2, 1) approximately equal

a) $71^0\ 34'$ b) $19^0\ 28'$

c) $70^0\ 32'$ d) $18^0\ 26'$

2-The measure of the acute angle between two straight lines $L_1: x - y - 3 = 0$,

$L_2:\ x = k,$

$y = 1 + k$ approximately equal

a) 19^0 b) 71^0 c) 18^0 d) 72^0

3-The measure of the acute angle between two straight line

$L_1:\ 2x + 3 = 15,$

$L_2: r = (-2, 1) + k(1, -3)$ approximately equal

a) 52^0 b) 51^0 c) 39^0 d) 38^0

4-If A (-2, 1), B(2, 3), C(-2, -4) ,then the acute angle between $\overleftrightarrow{AB}$, $\overleftrightarrow{BC}$ is

a) $tan^{-1}(1)$ b) $tan^{-1}(2/3)$

c) $tan^{-1}(3/4)$ d) $tan^{-1}(3/2)$

5-If the measure of the included angle between the two straight lines

$x = 7,\ y = ax + 2$, equal 90^0 then a=

a)0 b) 1 c) 90 d) -1

II-Prove that

1-The tringle whose equations of its sides are: $3x + 4y = 36,\ x - 7y + 13 = 0$ *and* $7x + y = 9$ is right angled and isosceles.

2-If $L_1: ax - 3y + 7 = 0$, $L_2:\ 4x + 6y - 5 = 0$, $L_3: \frac{x}{3} - \frac{y}{2} = 3$, then find the value between the value of a which makes:

a) The measure of the angle between the two straight lines L_1 *and* L_3 equal 0^0

b) The measure of the angle between the two straight lines L_1 *and* L_2 equal 90^0

4. Results of Research

We explained the second lesson, which was presented in this project, using Power point and the use of Activity, which we presented in the same lesson. Then we conducted a test (MCQ) on a group of students and registering their grades that they obtained in this test, and then we compared the grades that the students obtained after applying the technology that we presented in this project with their grades, which they obtained using traditional teaching methods, according to the following table.

Table (1): Student scores before and after using educational technology

Student	1	2	3	4	5	6	7
Traditional teaching	5	5	8	6	8	9	8
Teaching using technology	6	7	8	8	9	9	9

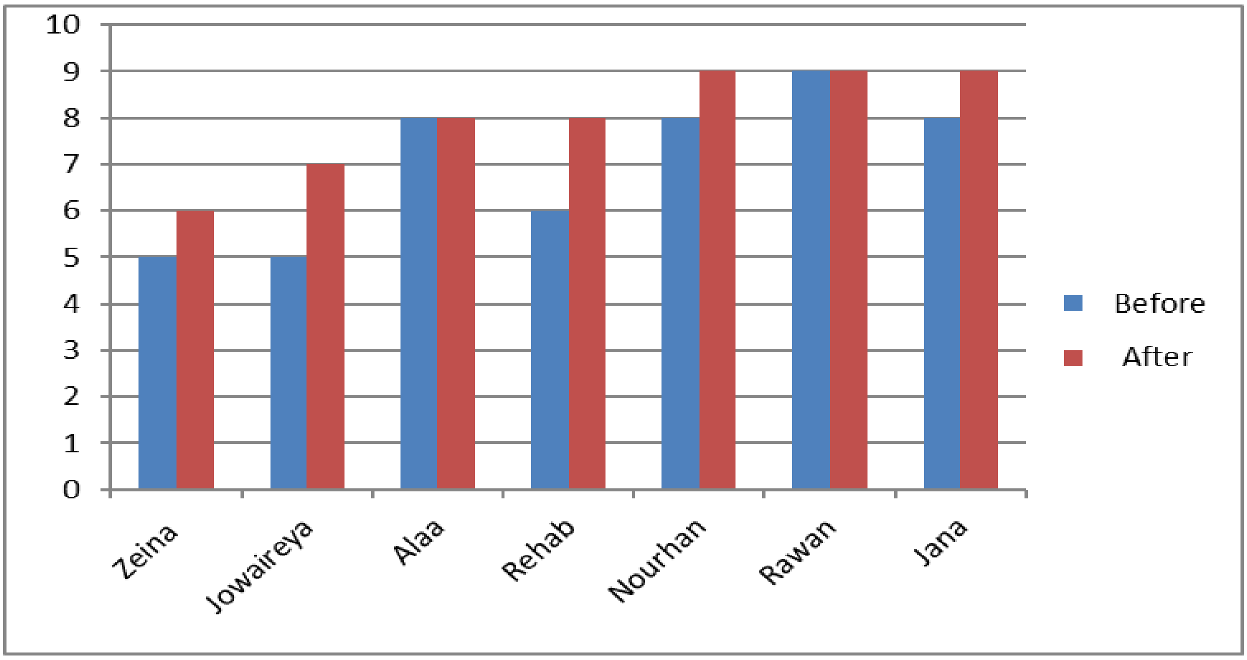

Figure (27): Illustration of student scores before and after using educational technology

5. Interpretation of Results

Observing the previous results, which were recorded in Table (1), which were further clarified in Figure 24, where the red colour columns represent the students' grades after teaching the test topic using educational technology, and the blue-colour columns represent the students' grades after teaching the test topic using traditional teaching methods. It is clear from Figure (24). The students' grades indicate that the use of educational technology in teaching has a positive impact on student achievement, and this is consistent with what was presented in the introduction to this project.

6. Conclusion

In this project, we studied the impact of educational technology on student achievement. We chose a unit of geometry for first-year secondary school students, and we are teaching this unit to the students using educational technology, represented by choosing various activities available on the Internet, which were presented in this project. We also prepared lessons for this project unit using PowerPoint. The students interacted significantly during the teaching process; the students had a clear role in the educational process. Then we trained the students to solve multiple different examples and problems in the lessons using these various activities. We conducted a test for the students through multiple choice questions, and the results indicated the positive impact of educational technology on student achievement, as we explained previously from during this project the figure (25).

Accordingly, we recommend to our fellow teachers to use educational technology in its various and multiple forms in teaching the mathematics course to students at different educational levels because this increases the role and effectiveness of students in the educational process. Also, the use of educational technology adds educational effects that remove students from boredom during the teaching process and makes the educational process easier, fun and engaging for students.

We also recommend to our fellow teachers to search for new things in educational technology by searching for various technological activities that help in the teaching process and that have a positive impact on student achievement.

7. Acknowledgement

We would like to acknowledge to the Faculty of Education, Ain Shams University. We also acknowledge to the Department of Mathematics, Faculty of Education, Ain Shams University, for providing the necessary support for the success of this project.

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