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DEVELOPING MULTIPLE INTELLIGENCES THROUGH ICT-BASED E-LEARNING PROGRAM

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Abstract

This study aims to determine the development of nine types of intelligence (Multiple Intelligences) through an e-learning program implemented through a computer network and/or personal computer (PC) with CD ROM. This type of research includes quantitative descriptive research, which describes the function of e-learning programs as a means of growth and development of all types of intelligence. The research method is carried out by comparing the pedagogical way of developing multiple intelligences with the facilities owned by the e-learning program. The degree of conformity used a percentage (%), then processed using a Likert Scale. Based on theory and virtual experiments, as well as the opinions of 2 experts and 35 education practitioners as junior/high school teachers, it was found that the e-learning program functions to facilitate the development of intelligence in the "distributed" category with a score of 4 (scale 1-5). The results of this study will help teachers and lecturers reflect on face-to-face learning so that during the Covid-19 period learning can be transferred to a system that uses an e-learning program that can accommodate the growth and development of multiple intelligences supported by technological advances. Moreover, this system does not require a network and signal but can be accessed in the form of a CD-ROOM/Flash Disk. In the future, learning like this can be a priority to be implemented.

Keywords: e-learning, ICT, multiple intelligence

Introduction

The theory of multiple intelligences supported that besides IQ, other factors determine a person's success, namely EQ and SQ factors. This theory argues that humans have nine types of intelligence that are different in dominance in each person so various methods and strategies are needed in the learning process. Variations in the delivery of learning materials are very important so that the learning process can accommodate the growth and development of all types of intelligence evenly without distinguishing some intelligence that is considered to be the most important.

Every child has dominant intelligence, and the learning process should give

more attention to accommodate each intelligence to develop so that each child can develop optimally. In line with the findings of the multiple intelligence theory, currently, the role of ICT in all aspects of life is very dominant. The role and ability of ICT be able to use to create learning programs that have a function to accommodate optimal development of all types of intelligence.

The ability of the computer as an e-learning medium is possible to create an interactive multimedia learning accommodation so that users of learning facilities be able to be active, reactive, or passive. Computers equipped with learning programs allow individual learning because teaching materials and exercises can be arranged according to the user's intelligence development model. E-learning with ICT can "concrete" abstract concepts so that they are easily understood by students. It can be realized with the help of computers.

E-learning is defined as a form of information technology that is implemented in education as a form of a virtual school (Purbo & Hartanto, 2002). ICT-based education is a form of education in which learning is done through computers by utilizing information technology (Putra, 2009). CD-ROM-based E-Learning allows teaching materials to be accessed by students on a portable basis, then learned on a computer. Another opinion says that e-learning is a learning process carried out through electronic mediums, such as the Internet, Intranet, Extranet, CDROM, videotape, DVD, TV, Mobile, PDA, etc. (Team e-learning, 2004).

Multiple intelligences

Multiple Intelligences, published in 1993 by Gardner. Gardner defines intelligence as the ability to solve problems and produce products that be able to be set in real situations. (Suparno, 2008). Based on that definition, it is clear that a person's IQ ability cannot be measured only by working on written test questions but must measure all types of intelligence that were manifested in all life activities. It was included in the Intelligence of Linguistics, Mathematical-logical, Space-visual, Physical-Kinesthetic, Musical, Interpersonal, Intrapersonal, Environment, and Executions Intelligence. An ability namely intelligence if someone shows a skill and that skill can solve problems and difficulties found in his life (Suparno, 2008).

Multiple intelligences, e-learning, and ICT

The impact of multiple intelligences on e-learning activities shows that tight integration of multiple intelligence together with e-learning models was good for use in learning (Mankad, 2015). Researchers in Turkey concluded that online education is multimodal that can support multi-literacy because some intelligence can be tracked and facilitated through analysis of multimodal learning in online mode. However, online teacher training in online education, both in technology implementation and educational theory adaptation was needed to achieve these ideas (Perveen, 2018).

Furthermore, to maximize the potential of students in South Africa, be able to do by learning based on multiple intelligences (Gouws, 2008). Learning research found that students who study in off-line mode or on-line mode through adaptive learning and the Adaptive Intelligent E-Learning system successfully classify learners at 85% of accuracy (Bhaskaran, et al 2014). The e-Learning program can be made to support all intelligence to grow and develop optimally (Pappas, 2005).

Schools and Universities be able to use e-learning models to minimize the dropout level of distance learning courses and to promote the success of students (DeGennaro, 2010).

The relationship between multiple intelligences and online education shows that multiple intelligences influence education outcomes, a good understanding of the impact of multiple intelligences in various categories can help instructors and students to create a conducive learning environment to provide useful educational outcomes (Riha et al., 2009). The experts on the MILA model in Thailand concluded that the MILA model (Multiple Intelligences Learning Activities) has appropriated factors and it has a very good category to be used in teaching and learning activities (Tangwannawit et al., 2008). European research about Howard Gardner's Multiple Intelligence provided by open and distance learning models concludes that some open and distance learning were not a medium for disseminating education, but it should be a medium for achieving new levels of understanding and awareness, that reflecting the role of education (Vieira et al., 2014).

Similar research says that Virtual Classrooms can provide more attractive options if implemented with the right approach (Marie, 2009). Virtual Learning is in great demand because its potential has been proven to streamline the learning process (Haryono & Alatas, 2012). Along with the findings of the latest research above, it is characterized by a cyber-shaped learning format (e-learning) via computers and the internet (Kim, 2015).

The results of another test through a questionnaire of 45 respondents proved that the project requirements using the Product-Service System (PSS) model to determine the e-learning development roadmap as a whole were implemented in a good and feasible to be realized (Risnandar, 2010). Research on the use of Interactive 3D e-learning in SMP No. 151 and MTs No. 77B/95 Bandung shows that Interactive 3D e-learning is preferred and highly preferred as a learning medium 74%, improves cognitive abilities 83%, is interesting and easy to use 77 %, motivates and attracts interest in learning 78%. (Sianipar, 2010).

In recent research, there has been a learning format in a Cyber (e-learning) form that is through computers and the internet (Sempurna, 2012). Online classes tend to be successful if it supported by pedagogical science and the preparation of the right teaching material (Mustadji, 2011). E-learning facilitates students to learn freely, and independently, understand abstract things easily, and be able to do practicum virtually (Mustadji., 2011). Physics learning is good for students when implemented by a good and true animation (DePorter & Hernacki., 2011). The use of computers created meaningful learning, efficient management of learning, and student administration was more effective (Morten Brekke, et al, 2010). The limited ability of lecturers to manage to learn be able to help by the use of ICT- based learning (Nawaz, 2013).

Student learning activities and achievements were increased in the subject of web-based real analysis as an e-learning form. The percentage of student learning completeness was achieved at 92.5% (Kurniati et al, 2014), E-learning effectiveness as planning has 77.57%, material making has 75.14%, material delivery has 66.14%, interaction has 75%, evaluation has 69.01%, and learning medium has 77.27% (Hanum, 2013). Students of JPTE PT UNM were motivated by learning Electrical Installation 2 using Adobe Flash CS3 animation and it has a good

category in 75% (Hasrul, 2011). Development of Learning Physics with ICT-Based Multiple Representations able to improve student concepts mastery of kinematics, perceptions, and good motivation (Ishafit, 2014). Biology learning that used e-learning based on multiple intelligences in the human motion system shows that student learning outcomes increased by 21% and learning completeness reached 100%, so the student learning process became effective (Murdiyani, 2012).

E-learning as an Information Technology-based interactive learning medium was realized in the form of modules about teacher content that includes: questions, announcements, uploading teaching material, and reviewing and announcing exam results. It has student content that includes viewing announcements, exam results, and downloading teaching material. This is a very good way as used as an Information Technology based interactive learning medium (Yazdi, 2012). The development of an interactive Integrated Science learning medium in the form of a web contains a front page, introduction, and course pages. The course page was consistent with Course 1 contained competency maps, course 2 about concept maps, and course 3 about objectives, teaching materials, experiments, discussions, figures of science, summaries, and examination material that used resources and an activity menu in Science Learning (Safitri et al, 2012). The results of the study decided that the e-learning system of Learning Management that used ANP analysis was good to use and was able to improve the teaching and learning process at SMA N 10 Bandar Lampung (Hidayati, 2010). The development of Learning Methods Based on E-learning be able to implement as good when it is supported by network facilities, infrastructure, and the socialization of that method in the academic community in the Directorate of Diploma Program of IPB (Budi & Nurjayanti, 2012). Data mining techniques and decision-making systems can use in recommending teaching materials, books, lecture materials, and journals that were under the site users of elearning-ujb.net (Agus, 2010).

The E-learning model according to appropriate medium experts is worth in used with a good category of 3.98 scores and based on beta tests has very good categories with a score of 4.15, product testing has a good category with a score of 3.90, and effective improvement student learning outcomes as a 13.24 score (Zyainuri et al, 2012). Virtual laboratory-assisted e-learning is valid to be used, it was proved by the scores of experts for material aspects as 91.67%, medium aspects as 96.75%, student questionnaire scores for online practicum as 81.30%, for the small group stage as 81.50%, and they were very practical to use (Agustine et al, 2014). The use of the E-learning Program in Physics Learning can reduce student misconceptions by 71%, from 91.7% to 20.7% (Mayub, 2017). In line with that, there is the influence of the use of e-learning programs on student motivation in the category of moderately motivated (Score as 3.52 from the range of scores 1-5) and there is a significant relationship between e-learning programs and motivation to learn (Mayub, 2015).

Based on the description above, the problem can be formulated; "Whether dual intelligence development can be accommodated by ICT-based e-learning programs? And how much do ICT-based e-learning programs contribute to the growth of multiple intelligence development?". To answer the problems, it is necessary to set research objectives, namely; "To describe the function of the e-learning program as an accommodation for the development of all types of multiple intelligences and to find out how much the ICT-based e-learning program

contributes to the growth of the multiple intelligence". We raise this title based on our experience as lecturers who teach ICT-based Learning Development subjects in the Faculty of Teacher Training and Education of Bengkulu University, for Undergraduate and Graduate degrees, and also as lecturers at the UGM Vocational School who teach programming and control systems. This research was funded by the Research Grants of the Graduate School of Science Education in the Faculty of Teacher Training and Education of Bengkulu University in the 2017/2018 academic year.

Method

This research included to Quantitative Descriptive Research model that aimed to describe the functions of ICT-based e-learning programs as an accommodation for the development of multiple intelligences and how large these functions are. The e-learning program included to Research and Development model. This section describes the process of making ICT-based Learning Programs for the Learning Program test. The process of making the Learning Program includes Analysis, Design, Code, and Testing (Mayub, 2011).

Analysis

The research analysis used is an analysis of the needs for software, hardware, and human resources needed for the realization of the e-learning program. The e-learning program must contain the features needed to be able to accommodate the growth of multiple intelligences. In this paper, Macromedia Flash software was needed, a set of computers/laptops, a person who understands physics, and a programmer.

Design

For the e-learning program to be able to accommodate the growth of multiple intelligences, it needs some study learning features that be able to display the text, images, graphics, tables, animations, simulations, feedback, data input, reactive, virtual experiments, dialogue, and sound. So it requires some learning modules which consist of modules, materials, animations, simulations, demos, assistance programs, problem answers, and evaluation modules.

Writing Program

The program was created by ActionScript Program. The button was used for system interactivity with the user.

Trial of E-learning Programs

Trials were conducted to ensure that e-learning programs can be operated and used for physics learning processes that accommodate the growth of all types of intelligence. The purpose of the test consists of; Whether the program runs as planned. Whether all buttons be able to function for interactivity? And whether the results of program execution were by the concepts of physics. Testing was done by Play and Test Movie. For this reason, it is necessary to make stages such as Figure 1

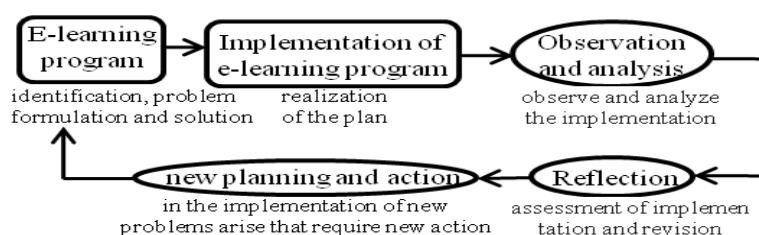


Figure 1. The stages of making an e-learning program

Test of e-learning program as a forum for the development of multiple intelligences

Time and subject of research

This research was conducted for 6 months from April to October 2020, using the subject of basic Two-Dimensional Motion of Physics Teaching material. To get the data about the function of the e-learning program as an accommodation for the development of multiple intelligences, pedagogical criteria were used to describe the activities that accommodate multiple intelligences. These activities were detailed for each type of dual intelligence, see Table 1

Table 1. Pedagogical indicators for developing multiple intelligences

No	Type of Intelligence, how to develop it	Display on an e-learning program
1	Linguistics: reading, writing, telling stories, and so on	Text display, visualization, graphics, simulation, animation
2	Mathematical-logical; problem-solving training logical thinking, reasoning, symbolism, systematic analysis of abstract concepts, systematically, using sketches.	Display text, graphics, images, curves, visualization, graphics, simulations, animations, enter data, sketch, and execute programs
3	Musical; musical instruments, students are directly involved	Visualization, simulation, animation, hearing sound.
4	Kinesthetic; experimentation, data input, demonstration	Simulation, input experimental data, animation, and running programs
5	Visual space; colors, design forms, patterns, images, graphics, symbols, sketches.	Graphics, animation, text, simulations, animated drawing exercises, quantitative analysis.
6	In Interpersonal; group learning, students conclude their opinions based on the results of group work	Exercise, quantitative analysis, feedback, active, reactive, group instructions
7	Intrapersonal, reflecting, thinking strategies, processing emotions, knowing oneself, practicing concentration.	Text, animation, graphics, simulations, quantitative analysis, feedback, training, individualized instructions, active, reactive
8	Environment; being natural as a means of learning, nature is developed into a teacher	Simulation, animation, practice, visualization, quantitative analysis
9	Existential, school direction so students are aware of their existence, and for what they are, leading to philosophy.	Simulation, animation, practice, quantitative/qualitative analysis, feedback, and compare

How to get data

The data about the function of the e-learning program as an accommodation for multiple intelligence development was obtained by making a checklist (x) for

the score or option (1,2,3,4,5) in the function of the e-learning program that compared/adjusted with pedagogical indicators development of multiple intelligences. The method used in this research was the Likert scale (Sugiyono, 2017). The person who was competent to do this checklist consisted of 2 experts and 35 education practitioners, middle school and high school teachers.

How to process data

The data was processed by a percentage (%) of suitability between facilities' e-learning programs with pedagogical activity indicators of dual intelligence development using a Likert scale (Sugiyono, 2017), see Table 3. Based on Table 3, it can be seen that the function/facility scores of the e-learning program as an accommodation for the growth of multiple intelligences range from 9 - 45. The minimum score is $9 \times 1 = 9$, while the maximum score is $9 \times 5 = 45$. When using a Likert scale, it will be got 5 categories in a width interval score for one category as 45: $5 = 9$ (Sugiono, 2017).

Table 2. Indicators / criteria for determining categories

No	Categories	Suitability of x with y	Score
1	Very available	$X \geq 81\%$	5
2	Available	$61\% \leq X \leq 80\%$	4
3	Available enough	$41\% \leq X \leq 60\%$	3
4	Not enough available	$21\% \leq X \leq 40\%$	2
5	Not available	$X \leq 20\%$	1

Information: x = how to develop intelligence, y = facilities available in the E-learning Program X = percentage (%) suitability of x with y

Table 3. How to process data

No	Type of Intelligence	Functions in the E-learning Program				
		Very available	Available	Available enough	Not available	Not enough Available
1	Linguistics.					
2	Mathematic-logic					
3	Musical					
4	Kinesthetic					
5	Visual space					
6	Interpersonal					
7	Intrapersonal					
8	Environment					
9	Existential					
	Total score					
	Average score	$[\Sigma (5) + \Sigma (4) + \Sigma (3) + \Sigma (2) + \Sigma (1)]: 9$				

Data analysis

Table 4 Data analysis uses the following criteria

No	Category	Interval score	Score
1	Very distributed	37- 45	5
2	Distributed	28 – 36	4
3	Distributed enough	19 – 27	3
4	Less distributed	10 - 18	2
5	Not distributed	0 – 9	1

Hypothesis

1. An ICT-based e-learning program be able to use as an accommodation for the development of multiple intelligences
2. ICT-based e-learning programs contribute to the development of multiple intelligences.

Findings and Discussion

The results of the research show that almost all types of student intelligence can accommodate to grow and develop through ICT-based e-learning learning programs. But the forms of ICT-based e-learning programs cannot yet be specifically intended for certain types of intelligence. One type of this program can accommodate several types of intelligence because there is no strict limit on the type of intelligence of a person. A person can have several types of intelligence, but not all types of intelligence stand out on that person, only a part of it, and for each person, the type of intelligence that stands out is not the same.

Table 5. Recapitulation Scores for the contribution of ICT-based learning programs as an accommodation for the development of multiple intelligence

as an accommodation for the development of multiple intelligence																		
No	Type of Intelligence	Functions / Facilities in the E-learning Program															Total Score	Average score
		4,1 - 5			3,1 - 4			2,1 - 3			1,1 - 2			1				
		a	b	c	a	b	c	a	b	c	a	b	c	a	b	c		
1	Linguistics.	5	5	4,8													14,8	4,93
2	Mathematical-logical	5	5	4,7													14,7	4,90
3	Musical				4	4	3,9										11,9	3,97
4	Kinesthetic							3		3,1		2					8,1	2,70
5	Visual space	5	5	4,8													14,8	4,93
6	Interpersonal				4	4	3,8										11,8	3,93
7	Intrapersonal				4	4	3,7										11,7	3,90
8	Environment				4	4	3,9										11,9	3,96
9	Existential											2	2	2			6,3	2,10
	Total Score	15	15	14,3	16	16	15,3	3	0	3,1	2	6	2	0	0	0	108	4,0

$$\text{Average} = \{[(a + b + c): (9 \times 3)]\} = \{[(15+15+14,3+16+16+15,3+3+3+3,1+2+6+2,3):27]\} = 108,0 : 27 = 4,0$$

Information: Very available (5), Available (4), Sufficiently available (3), Less available (2), Not Available (1), and a = score by expert 1, b = score by expert 2, and c = average score by teachers.

Based on the data, the ICT-based e-learning program can accommodate the growth of multiple intelligences in the distributed category with a score of 4.00

(scale 1-5). The function of the e-learning program in the type of kinesthetic intelligence was relatively small (2.70) because this intelligence will develop optimally if students directly engage in real activities, but in e-learning programs can only be done virtually through the skills of students using the mouse. The function of e-learning programs in Existential intelligence was also relatively small (2,10).

This is due to the type of intelligence that was relatively difficult to evaluate because it was relatively absent and difficult to measure as a result experts and teachers give relatively small scores. Where Linguistic, Mathematical-logical, and Space-visual intelligence was almost perfectly accommodated with scores of 4.93, 4.90, and 4.93. Learning features in e-learning programs can accommodate the growth of linguistic intelligence such as text, visualization, graphics, simulations, and animations that can be read, observed, and told by students. Learning features in e-learning programs can accommodate the development of mathematical-logical development such as text, graphics, images, curves, visualization, simulation, animation, entering data, sketching, and executing programs that can be used by students in learning. See Table 6.

The findings of e-learning program contribution in developing multiple intelligences were obtained the same result found in various countries. The experts in Thailand found that; the indicators in the MILA model (Multiple Intelligences Learning Activities) were appropriate and it was in a very good category that is used in the learning process (Tangwannawit, et al, 2008). European research also found that open and distance learning models that contain Howard Gardner's multiple intelligences not only as a medium to spread education, but act as a means to reach new levels of understanding and awareness, and also reflect the role of education (Vieira et al., (2014). Research in South Africa found that to optimize the potential of students, learning is carried out based on multiple intelligences (Gouws, 2008).

The findings were also in line with other research that said that multiple intelligences have an impact on e-learning activities that tight for integration of multiple intelligence with e-learning models (Mankad, 2015). All types of intelligence can grow and develop optimally in the learning process when applied and supported by e-Learning programs (Pappas, 2005).

Conclusion

Multiple intelligence can be developed through e-learning programs that were realized in the e-learning modules, The nine types of multiple intelligence in theory and virtual simulation be able to develop through e-learning programs. It can see that the function of e-learning programs as a medium of intelligence in the category of Distributions with a score of 4.0 (scale of 1-5).

Table 6. The comparison of capabilities of ICT-based e-learning programs as an accommodation for developing multiple intelligence

No	Type of Intelligence or how to develop it/ e-learning Program	Forms in e-learning programs
1	Linguistic: Reading, writing, telling stories, and so on E-learning Program: Text display, visualization, graphics, simulation, animation	Problem 1. What is meant by rocket motion and what are the laws of physics that apply to rocket motion → 2. Since firing until the fuel runs out, what motion is there on the rocket → 3. Explain the meaning of rotational kinematics →

Mathematical-logical:

Problem-solving, training logical thinking, reasoning, symbols, analyzing abstract shelf concepts

- 2 systematically, using sketches
Elearning Program: Display text, graphics, images, curves, graphics, visualization, simulations, animations, entering data, sketching and executing programs

- 3 Musical: In musical instruments, students are directly involved.
E-learning Program: Visualization, simulation, animation, hearing sound.

- 4 Kinesthetic: Experimentation, data input, demonstration.
E-learning Program: Simulation, virtual experimental data input, animation, and running
Visual space: colors, shapes, design patterns, images, graphics, symbols, sketches.

- 5 E-learning Program: Graphics, text, animation, analysis, simulations, animated drawing exercises, quantitative

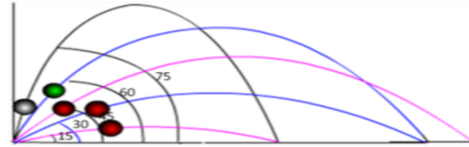
- Interpersonal: In Group learning, students conclude their opinions based on the results of group work
6 E-learning Program: animation for quantitative/qualitative analysis of symptoms, instructions are group
Intrapersonal: Reflecting, emotions, thinking strategies, processing
7 knowing oneself, practicing concentration.

- E-learning Program: Text, animation, graphics, reactive, active, simulations, quantitative analysis, feedback, training, individualized instructions

- Environment: Being natural as a means of learning, nature is developed into a teacher.

- 8 E-learning Program: Simulation, practice, animation, visualization, quantitative analysis

It has been proven that for the horizontal plane the distance of shoot $OD = R$ will be maximum if the angle of elevation is $45^\circ = \frac{1}{2}$ times the angle between the plane and the vertical line. This also applies to the inclined plane up or down to point O. So the angle of elevation β so that R is maximum 45° . view image



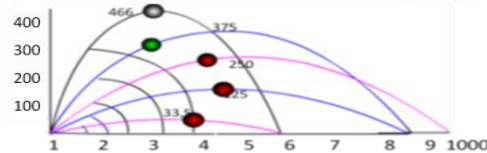
simulation, animation, visualization, and listening to sounds, as well as virtual experiments

Motion Satellite

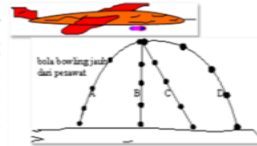
Name : Stellite (1,4,8,12,16,20,24,4&16,4&24)
Radius :



Demo bullets with various elevation angles

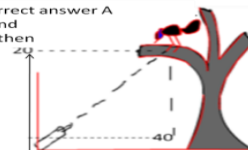


A bowling ball accidentally falls from an airplane flying horizontally. As seen from the ground, which path the bowling ball made after it comes off airplane

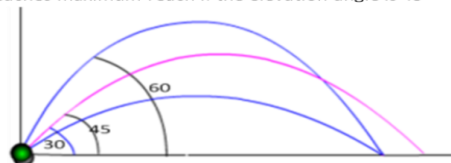


11. Wrong answer B / C / D. Correct answer A

Because $y = Vo^2 \sin^2 \alpha / 20 = 20$ and $x = Vo^2 \sin 2\alpha / 10 = 40$, then
 $\sin^2 \alpha / 20 = 20$ and $\sin 2\alpha / 10 = 40$,
the meaning $\sin 2\alpha = 400$ and $\sin^2 \alpha = 800$ or $(\sin^2 \alpha) = 2 (\sin 2\alpha)$
the meaning $\alpha = 45^\circ$
while speed is $(vo^2 \sin 2\alpha) / 40$, or $(vo^2 \sin 90^\circ) / 20 = 40$,
 $vo^2 = 800 \rightarrow vo = 28,5 \text{ m/s}$

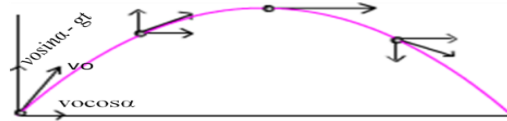


1. The correct answer is Height (hMax.) = $Vo^2 \sin^2 \alpha / 2g$, then for (hMax.) The value of $\sin^2 \alpha = \max. = 1$, consequently $\alpha = 90^\circ$, this means the bullet will reach max height if the elevation angle is 90° Maximum range (Rmax.) = $(vo^2 \sin 2\alpha / g)$, then for Rmax. The value of $\sin \alpha = \max. = 1$, consequently $2\alpha = 90^\circ$, $\alpha = 45^\circ$ The bullet reaches maximum reach if the elevation angle is 45°



- 9 Existential: school direction so students are aware of their existence, and for what they are, leading to philosophy.
E-learning Program: Simulation, animation, practice, analysis, and compare quantitative /qualitative feedback.

Parabolic motion is a combination of regular straight motion with on the X axis in a straight motion that changes regularly on the y-axis. It is called parabolic motion because the graph of $y = f(x)$ is in the form of a curve



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