An Analysis of *Mimosa pudica* Leaves Movement by Using LoggerPro Software

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Abstract. The unique phenomena of *Mimosa pudica* are the closing and opening movements of its leaves when they got a stimulus. By using certain software, these movements can be drawn into graphic that can be analysed. The LoggerPro provides facilities needed to analyse recorded videos of the plant’s reaction to stimulus. Then, through the resulted graph, analysis of some variables can be carried out. The result showed that the plant’s movement fits an equation of \( y = mx + c \).

1. Introduction

Information and Communication Technology (ICT) has become parts of people’s daily life around the world. Its vast development makes science education standards emphasize the use of technology in the teaching and learning process. It helps to make connections between what is learned in the classroom and what is natural in life outside the classroom. In turn, it leads to a more advanced understandings and deeper concepts of nature. Its use in the classroom serves as an excellent tool to help science teachers meet the instructional objectives.

To a certain condition, ICT has become relatively inexpensive. That’s why it provides excellent opportunities for science teachers to enhance their teachings. Video analysis software and video clips, which are now relatively cheaper and easily found, can help students to collect data. Then, with the help of ICT, data are manipulated, analyzed, and described more easily, quickly, efficiently and accurately [1].

Plant leaves’ movements can be differentiated in two ways: reversible (swelling) and irreversible (growth) changes in cell volume. In contrast to typical growth movements, turgor-regulated movements are reversible. They have been observed in many plants, e.g. Mimosa, Phaseolus, Albizzia, Desmodium and Samanea, which possess specialized motor organs called pulvini. As the direction of leaf movement is determined by the architecture of the pulvinar joint and not by the direction of the controlling stimulus, this type of movement is referred to as nyctinastic or seismonastic. The seismonastic leaf movement of *Mimosa pudica* is associated with rapid water transport across cell membranes. In mature motor cells of *Mimosa pudica*, two types of vacuole were identified: small vacuoles containing large amounts of tannins and big aqueous vacuoles. Fast efflux of potassium ions through outward-rectifying ion channels followed by water efflux leads to a rapid turgor loss [2]. Thigmonastic or seismonastic movements in *Mimosa pudica*, such as the response to touch, appear to be regulated by electrical, hydro dynamical and chemical signal transduction. The pulvinus of *Mimosa*
pudica shows elastic properties. It is also found that electrical or mechanical induced movements of the petiole were accompanied by a change of the pulvinus shape [3].

*Mimosa pudica*, part of Papilionaceae, has unique characteristic, its rapid reaction when it is stimulated by touch, heat, etc. The movement of this sensitive plant can be seen clearly without using any equipment. The ‘dead’ condition of this plant is just temporal. The leaves will back to the previous condition after a few minutes [4].

LoggerPro software is also an effective media in learning math and science. Students can learn the functions of symbols, graphics and others. By using this media, it will save time and money and makes learning more effective. Video analysis technology changes the way of teaching and learning Math and Science. The use of this software shows the pedagogy model, ICT literation building and increases teachers’ professionalism [1].

Based on the above arguments, this paper is intended to show how the form of the opening and the closing of *Mimosa pudica* can be presented in the form of picture of graphic with the help of LoggerPro software.

2. Methods

The research is conducted as follows: (1) defining kinds of *Mimosa pudica*, (2) finding habitat of the *Mimosa pudica*, (3) giving stimulus to the leaves (4) recording every movements or reactions; beginning from its normal condition (open), when it is touched (close), and back to its previous condition (re-open), (5) analyzing result of the recordings using LoggerPro, (6) drawing conclusion of the experiment/analysis.

3. Result and Discussion

The process of analyzing *Mimosa pudica* begins by converting JPEG file to mov.file because LoggerPro can only read extension movie file. The sequence is as follow: first, open LoggerPro, select Insert, Movie then choose the file that will be analyzed. Then, select Enable/ Disable video analysis, select Add Point, Set Scale, Set Origin then select Add Point. The result is shown in Figure 1.

Result of this observation is shown in Figure 1, X describes the horizontal direction of displacement distance from the tip of the leaves when they are closing and opening. Y describes the displacement direction vertical distance from the tip of the leaves when they are closing and opening. The path traversed shaped leaf tip curved lines, so that the distance y and x depends on the angle formed. The formula is:

\[ X = l \cos \theta \quad \text{and} \quad Y = l \sin \theta \]  

(1)

In this study the distances of the horizontal direction ignored and only used in the vertical direction and does not measure the changing magnitude of the angle, so the formula is:
Where $Y$ is the change distance tip of the leaf to the edge of the leaves, $l$ is the length of the leaf and $\theta$ is the angle between the x axis and the length of leaf. Shown in Figure 2.

The distance tip of the leaf to the edge of the leaves is shown by $Y$. The first position of $Y$ is the position of Mimosa pudica before stimulated. The length of $Y$ can be seen in the analysis data on the LoggerPro when it is clicked at the edge of the leaves $Y$ shows 0.6002, means that the real length of the leaves times to used scales. On the set scale it is used $1 = 0.05 \text{ m}$, so the length of the real leaf is $0.6002 \times 0.05 \text{ m} = 0.031 \text{ m} = 3.1 \text{ cm}$. The change of the $Y$ leaves is touched and back to the previous conditions is shown in the Figure 3.

$$Y = l \sin \theta \quad (2)$$

The horizontal line is as the changing position in a horizontal way, the vertical line is as the width of the leaf and the width changes. The next step is follow the movement of the leaf by giving blue mark by adding point. This step is done until the movement stopped. If the insert is clicked then click the graphic, it will show the graphic of the movement. To know the function of the graphic, click curve vit.

**Figure 1.** The video of *Mimosa pudica* before stimulated

**Figure 2.** The changing angle between the x axis and length of the leaf.

**Figure 3.** The graph of *Mimosa pudica* before and after stimulated.
On the first part, the leaf gives rapid reaction. It needs about 2.75 seconds (from 1.75 seconds until 4 seconds) to close. It is shown clearly on the video analysis. After mechanical stimulation of a petiole or a pulvinus, a petiole falls in a few seconds [3]. The touch is given after 1.75 seconds and the length of the leaf is $0.06617 \times 0.05 \, \text{m} = 0.033 \, \text{m} = 3.3 \, \text{cm}$. In short period, there is a movement of closing (move to horizontal line) to a movement of stop. This is condition shown Figure 3. After analyzed by LoggerPro software and moved in to Excell, written mathematically as follow.

\[ Y = -0.2003x + 0.8245 \]  

(3)

Where $R^2 = 0.8391$, it means measurement is valid.

![Graph 1](image1)

**Figure 4.** Initial position graph while they got stimulus and the leaf gives rapid reaction.

![Graph 2](image2)

**Figure 5.** Stationer (at least) graph the leaf reaction.

![Graph 3](image3)

**Figure 6.** Graph position when the leaf starts to open again and back to the previous condition.

Figure 5 is the changing graphic when the leaf looks stand still (before it opens again). It needs about 6 seconds (4 until 10 seconds). It is shown by graph horizontal line, means that the leaf of *Mimosa pudica* does not have much activity. The third part is when the leaf starts to open again and
back to the previous condition. It is shown in Figure 6. It needs about 400 seconds (11 seconds until 400 seconds). The previous research stated that the relaxes to the initial state in 10–12 minutes [3]. The difference time movement when the leaf receive stimulus and back to the previous condition is very far so that the graphic is become leap one another with the vertical axis. After the data analyzed by LoggerPro software and moved in to Excell, written mathematically as follow:

\[ Y = 0.0017x + 0.0773 \]  

(4)

Where is \( R^2 = 0.8236 \), it means measurement is valid

So, as it seen above, LoggerPro software is able to enhance learning motivation, raising higher order thinking skill by drawing and reading graphs, applying concepts, and diverging students’ thinking ability. LoggerPro can also stimulate the integration of biological, chemical and physics material [5]. Moreover, it gives interesting and fun experience for students to apply ICT in the learning process [1,5,6].

4. Conclusion.

LoggerPro is a good example of how software can be used in classes for teaching and learning science. In this paper we have reported how to explore the Mimosa pudica’s movement when they got stimulus. The time taken by the leaf to close depends on the magnitude of pressure given when it is touched, meanwhile the time needed to open back will not depend on the pressure. LoggerPro makes teaching and learning the phenomena of science special physical concepts and laws more interesting and easier for the students. LoggerPro software has also now been developed to teach other phenomena such as: projectile motion, ball motion when it is thrown, tug of war, sliding objects and other phenomenon. It gives more opportunities for exploring science in new contexts, teaching in richer environments and, undoubtedly, motivating students, and the teachers as well, to use multimedia to study physics.

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