



Facebook: Wind Tunnel WU



Submission form



VDO from the competition

## Overview

The windmill competition was a part of teaching and learning activities, arranged for freshmen in engineering program, of Principles of Physics I course, in academic year 2018, at Walailak University.

This activity had arrived after a lecturer questioned the students about "power" of a Dutch wind turbine operated pumping water, under steady wind flow and at a certain height. The students were reluctant to answer. Moreover, they misunderstood that the power efficiency increases as weight of water increases.

In basic theory, the power (P) of a wind turbine operated pumping water can be determined from energy (E) per unit time (t):  $P = E/t$ . For gravitational potential energy,  $P = mgh/t$ , when m is mass, g is gravitational acceleration, and h is height. Therefore, lifting to the same height, the P. is proportionally increased with m/t.

To help the students to understand the term of power from a real situation, the windmill competition was arranged. In this competition, each team of students had to build their own windmill for lifting mass. They have to design a windmill to reach the highest power.



## Aims and objectives

Students are able to **calculate power** and to **plot power curve** of a windmill operated lifting mass.

## Activity

Students form their teams (3 people/team).



Students accept regulation of the competition.



Students search information to design their windmills and fill in submission form.



Students test power efficiency in a wind tunnel and plot the power efficiency curve of their windmill.

Fig. 1 Activity chart

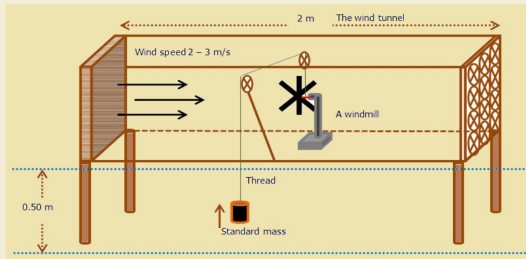


Fig. 2 The setup for testing power efficiency of a 25 cm x 25 cm x 25 cm - windmill

The regulation of the competition (see in QR-code) was announced 45 days before windmill contest. The students had to follow the process in Fig. 1. Students from other programs were invited to enroll in the competition, without application fee. This activity was supported by School of Science and colleagues from the Division of Physics.

The submission form (see in QR-code) was prepared by the lecturer. It contains open questions, such as how students design, what physics/engineering knowledge they apply, and how they test their windmills before the contest, including a table to record data. The data need to be recorded during power measurement of their own windmills, on the contest date. The measurement was performed by student teams, when the lecturer and other teams were observers.

Scoring was based on rank of windmill power of all teams and relevancy of detail in the submission form. The score was counted 10% for grading of Principles of Physics I course.

# UNDERSTANDING "POWER" THROUGH THE WINDMILL COMPETITION ACTIVITY

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Fig. 3 Photos from the competition

## Outcome

- The windmill competition was organized in collaboration of 2 courses, Principles of Physics I and General of Physics (for health science programs).
- 60 (20 teams) out of 300 students from Principles of Physics I participated in this activity (the rest joined water rocket competition, another option), and 45 students (15 teams) from other programs.
- More than 50% of submission forms showed that the students learnt how to measure power efficiency in prior. Some of them tried to set equipment available in their dormitory (e.g. an electric fan as wind generator, a biscuit-bag as a standard mass) for a testing.
- The students obtained power efficiency curves of their own windmills. An example was presented in Fig. 4. A student explained the curve that "the windmill can lift a small mass faster than a heavy one and the maximum power presents at an optimized mass".

## Impact

- A number of students mentioned that "this course has variety of activities related to physics and engineering that we can collect scores for a better grade".
- With agreement of colleagues in the Division of Physics, the competition will be taken place again next academic year.

## Future development of project

Next year, the content of the competition will be integrated with calculus. Also, the physics lecturer will engage students more knowledge on aerodynamics.

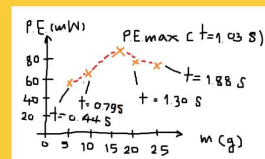


Fig. 4 A plot of power from a team of students

## References

R. Gandhi, et. al, (2017), Design and development of windmill operated water pump, International Journal of Recent Engineering Research and Development, 1(1), 12 – 38.