Enhancing Students’ Understanding in Simple Harmonic Motion by Using Video Analysis

Jiraporn Boonpo\textsuperscript{1}, Wiwat Youngdee\textsuperscript{2}, and Chaiyapong Ruangsuwan\textsuperscript{2*}

\textsuperscript{1}Department of Education in Science and Technology, Faculty of Education, Khon Kaen University, Khon Kaen, Thailand

\textsuperscript{2}Department of Physics, Faculty of Science, Khon Kaen University, Khon Kaen, Thailand

\textit{Siam Physics Congress 2015}

\textit{Krabi, Thailand, 20\textsuperscript{th} May 2015, 16:45-17:00}
• Introduction
  • Why we study students’ understanding in SHM?
  • Why we used video analysis to improve it?

• Objective

• Materials and Method

• Results and discussion
  • Students’ understanding in velocity, acceleration and restoring force.

• Conclusion
Simple Harmonic Motion (SHM)

SHM concepts are important in physics and several applications.

Students should understand both theoretical representations and calculations to effectively understand.

But

- most students have difficulties in relating concepts with graphical representation
- mathematical calculation makes students shy away
Introduction: Why we use video analysis?

Video analysis:

- The cost of equipment is minimal.
- Allows for the study of motions that are not easy to do in the traditional lab.
- Allows real-world situation analyzed.
- Multiple representations (Graphs, diagrams, tables and strobe picture) are support students’ understanding by building a link between theory and experimentation.
- Students can analyze complex situations even if they don’t have strong mathematic skill.

(Desbien, 2011) (Klein, Gröber and Müller, 2014)
White and Gunstone (1992) have promoted the **predict–observe–explain (POE)** procedure as an efficient strategy for eliciting students’ ideas and also promoting student discussion about their ideas.

- **Predict**: Students are predicting the result of a demonstration and discussing the reasons for their predictions.
- **Observe**: Students are observing the demonstration.
- **Explain**: Students are explaining any discrepancies between their predictions and observations.

*(Kearney, Treagust, Yeo and Zadnik, 2001)*
Objective

• To enhance students’ understanding of velocity, acceleration and restoring force of SHM by using POE approach integrated with video analysis.
Materials and methods

Participants

- 37 ten grade students at Satrichaiyaphum school, Chaiyaphum province, Thailand.

Instruments

- Six items SHM conceptual test
- Worksheet and two lesson plans based on POE approach
Data collection

Pre-test

Students did the activity based on POE approach

Observe

by using “VDO analysis”

- Students did experiment and collect data.

- Students analyzed data.

Post-test

Predict

Mass attached spring

Simple pendulum
Five levels of student understanding following Westbrook and Marek, 1991:

- **NU**: incorrect information + don’t explain anything
- **AC**: incorrect information
- **PS**: understand concept + misconception
- **PU**: not completely scientific understanding
- **CU**: completely scientific understanding

Students’ understanding in post-test = Students’ understanding was developed
Misconception in pre-test:

- velocity of SHM is constant
- velocity equals zero at equilibrium point
- magnitude of velocity direct proportion to displacement and restoring force

Misconception in post-test:

- velocity equals zero at equilibrium point and maximum if displacement is maximum
- magnitude of velocity depend on restoring force and no restoring force at equilibrium point

The students’ understanding was developed 29.74%.
Results and discussion

Students’ understanding in direction of velocity

![Bar chart showing the percentage of students' understanding before and after instruction.](chart.png)

- **Misconception in pre-test:**
  - direction of velocity same as direction of force act to mass attached spring
  - direction of velocity is opposite with the direction of object movement.

- **Misconception in post-test:**
  - direction of velocity similar to object movement
  - it is the same direction both objects go away and return

The students’ understanding was developed 55.06%.
Results and discussion

Students’ understanding in magnitude of acceleration

- **Misconception in pre-test:**
  - Acceleration is zero at maximum displacement.
  - Acceleration is constant.
  - Acceleration depends on force and mass.
  - Acceleration is diverse portion with displacement.

- Also found in post-test

43.25% of student was developed to scientific understanding
Results and discussion

Students’ understanding in direction of acceleration

Misconception in pre-test:

• Direction of acceleration is opposite when mass turns back.
• Direction of acceleration is similar to velocity.
• Direction of acceleration follows to the direction of the moving object.
• Direction of acceleration difference from force.

found in post-test

64.84% of student was developed to scientific understanding
Results and discussion

Students’ understanding in magnitude of restoring force

- **Misconception in pre-test:**
  - Restoring force is constant.
  - If object is near equilibrium point, restoring force is increased.
  - Restoring force is decreased when it is near equilibrium point.
  - Restoring force is direct portion of velocity.

- **Misconception in post-test:**
  - magnitude of restoring force reverses to displacement.

51.35% of student was developed to scientific understanding
Students’ understanding in direction of restoring force

Misconception in pre-test:
- Restoring force is same/difference direction of force used for pulling mass.
- Direction of restoring force is difference when mass returned.
- Direction of restoring force point to the equilibrium point because of elastic potential energy.

- restoring force on the object is on the reverse motion of object.

59.45% of student was developed to scientific understanding
The POE approach with video analysis can improve students’ understanding of velocity, acceleration and restoring force, especially direction (>50%).

The magnitude can be compared and studied the relationship of graph representation from the video analysis.

The direction was clear to see from analysis results by using video analysis.
Acknowledgements

- The Promotion of Teaching Science and Technology (IPST)
- Department of Education in Science and Technology, Faculty of Education, Khon Kaen University
- Satrichaiyphum School, Chaiyaphum province
Thank you

Question ?