HIGH SCHOOL SCIENCE STUDENTS' DIFFICULTIES IN CONSTRUCTING SCIENTIFIC EXPLANATIONS IN BIOLOGY

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Presentation Outline

- Introduction
- Participants
- Data collection
- Data analysis
- Research findings
- Conclusion and discussions

Introduction of Scientific explanation

Scientific explanation is

- defined as one of the essential practices in science education (National Research Council,2000.)
- served as fundamental knowledge and skills in scientific inquiry (McNeill, K. L.; & Krajcik. J. S. ,2008)
- clamed that it could promote students understanding of science, and the nature of science (Bell, P. & Linn, M.,2000)

Introduction of Scientific explanation

scientific explanation

- **Claim:** Testable statement or conclusion that answers a scientific question. A scientific claim typically focuses on what happened, or how or why something happened.
- **Evidence**: Investigation data that helps to construct, support, and defend a claim.
- **Reasoning:** Statement given to justify claim, and show the link evidence to support the claim.

(Ruiz-Primo, 2008)

In science learning, students should be able to

(i) Give priority to evidence when developing or evaluating scientific explanations.

(ii) Formulate scientific explanations from evidence to address scientifically oriented questions.

(iii) Formulate and revise scientific explanations using logic and evidence.

(iv) Have a clear understanding that scientific explanations emphasize evidence.

Sadler ,2004.

In Thailand, Basic Education Core Curriculum states that high school students should be able to explain the results of an investigation based on evidence and support with scientific reasons, use evidence and conduct research to collect more evidence in order to accept or reject existing knowledge or idea.

Research Inquiry

How well high school students construct scientific explanations in biology, and which component of scientific explanation is the most challenging were provided.

Participants

The participants were 72 tenth-graders who are in a science stream and had studied ecosystem topic in the first semester of 2016. They were 29 female and 43 male students from a high school in Phrae province (northern Thailand).

Data collection

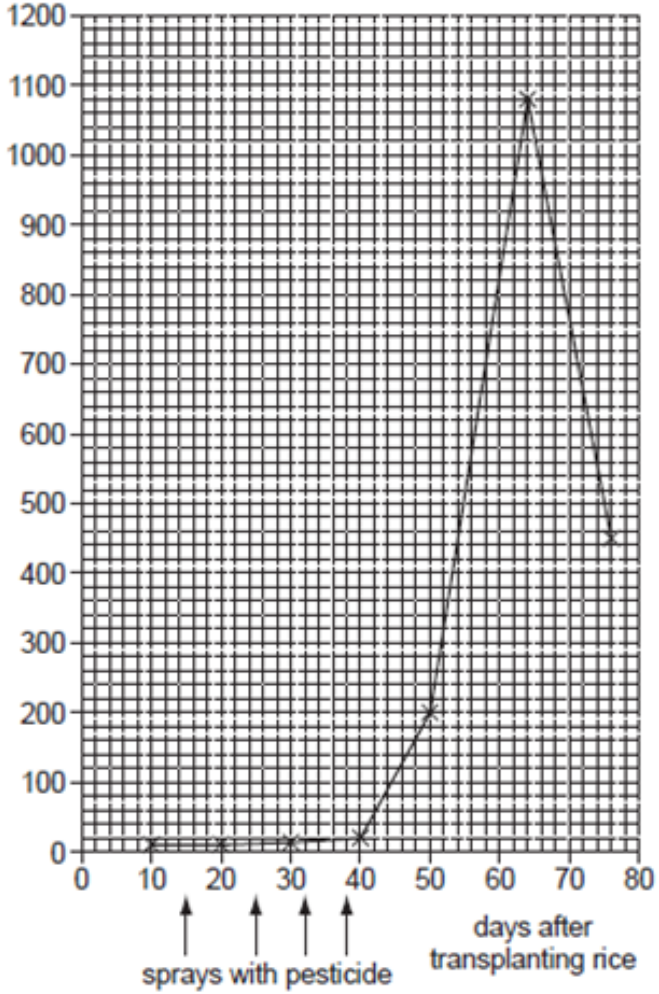
The research instrument

- Open-ended written test constructed by the researchers, and evaluated by three experts.
- The Index of item objective congruence (IOC) of all items was 1.0.
- The test includes 10 open-ended questions asking the students to write scientific explanations about energy flow in different ecosystems using evidence from the given data to support their explanation with relevant scientific reasoning.

Data analysis

- Each response was analyzed through three components of scientific explanation based on the work of McNeill, et al.
- Each component was categorized into three levels; 0, 1, and 2.
- Each student's response was coded and categorized then placed in each rubric level.

The brown plant hopper is serious insect pest of rice spraying with pesticides is common way to control it. However, brown hopper have become resistant to pesticides.



Use the information in fig 3.1 to describe the effect of pesticides on population of the brown plant hopper with the evident and reasoning.

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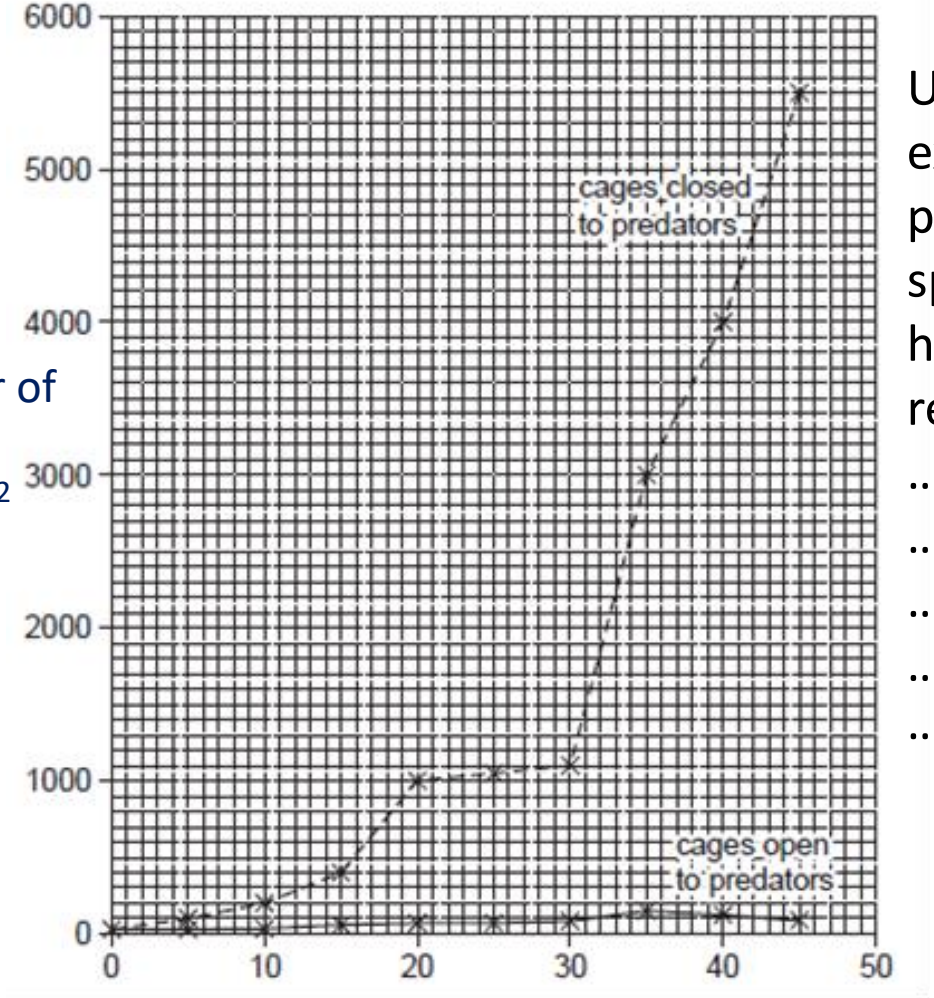
Example I

As an alternative to spraying pesticides, some farmers use predatory predator animals, such as the hunting spider to control brown plant hoppers.



Use the information in fig 3.2 to explain the advantages of using predators, such as hunting spiders to control brown plant hoppers with the evident and reasoning.

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Example II

Research findings

Students' ability in constructing scientific explanation related to the concepts of energy flow. (Claim)

Score	Criteria	Number of student (percent)
Claim: A conclusion that answers the question.		
2	Makes an accurate and complete claim	50 (69.4)
1	Makes an accurate but incomplete claim	20 (27.8)
0	Does not make a claim, or make an inaccurate claim	2 (2.8)

Research findings

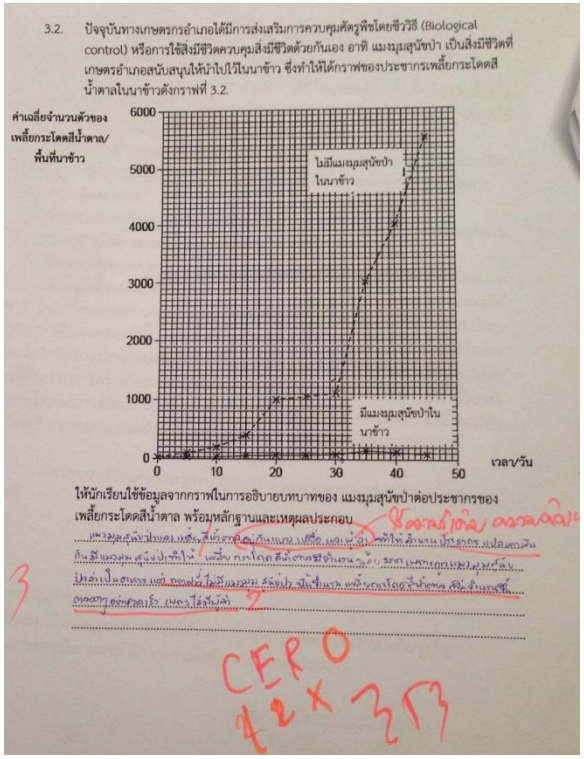
Students' ability in constructing scientific explanation related to the concepts of energy flow.(Evidence)

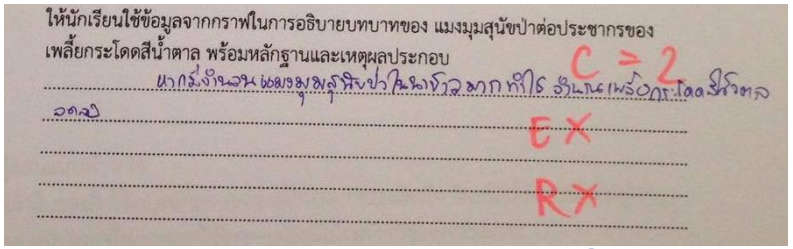
Score	Criteria	Number of students (percent)
Evidence: Appropriate scientific data that supports the claim.		
2	Provides appropriate and sufficient evidence to support claim.	19 (26.4)
1	Provides appropriate, but insufficient evidence to support claim.	23 (31.9)
0	Does not provide reasoning or only provides reasoning that does not link evidence to claim.	30 (41.7)

Research findings

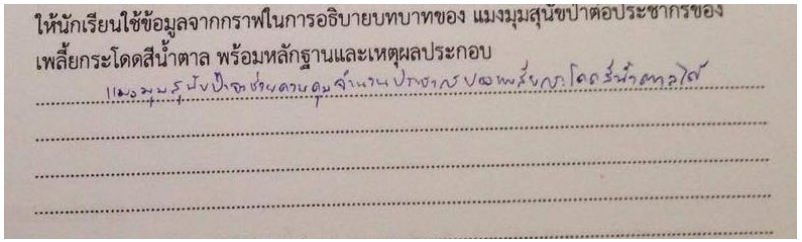
Students' ability in constructing scientific explanation related to the concepts of energy flow. (Reasoning)

Reasoning: A justification that links the claim and evidence.		
2	Provides reasoning that links evidence to claim. Includes appropriate and sufficient scientific principle	6 (8.3)
1	Provides reasoning that links the claims and evidence.	7 (9.7)
0	Does not provides reasoning or only provides reasoning that does not link evidence to claim	59 (82.0)

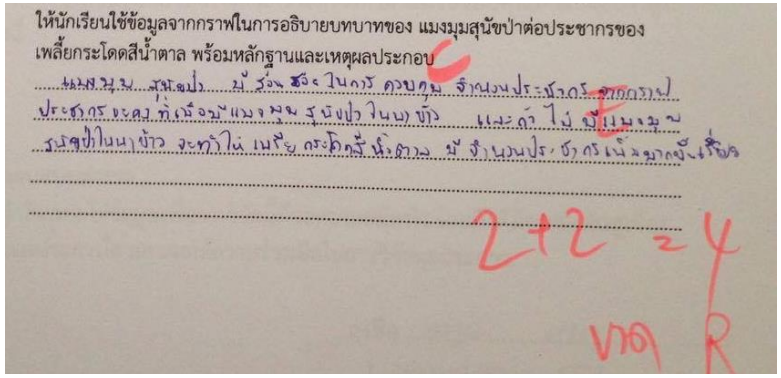


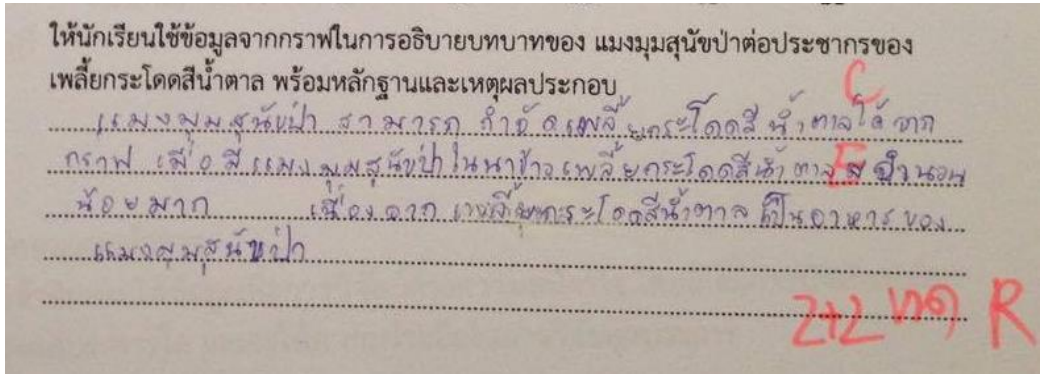


Claim only

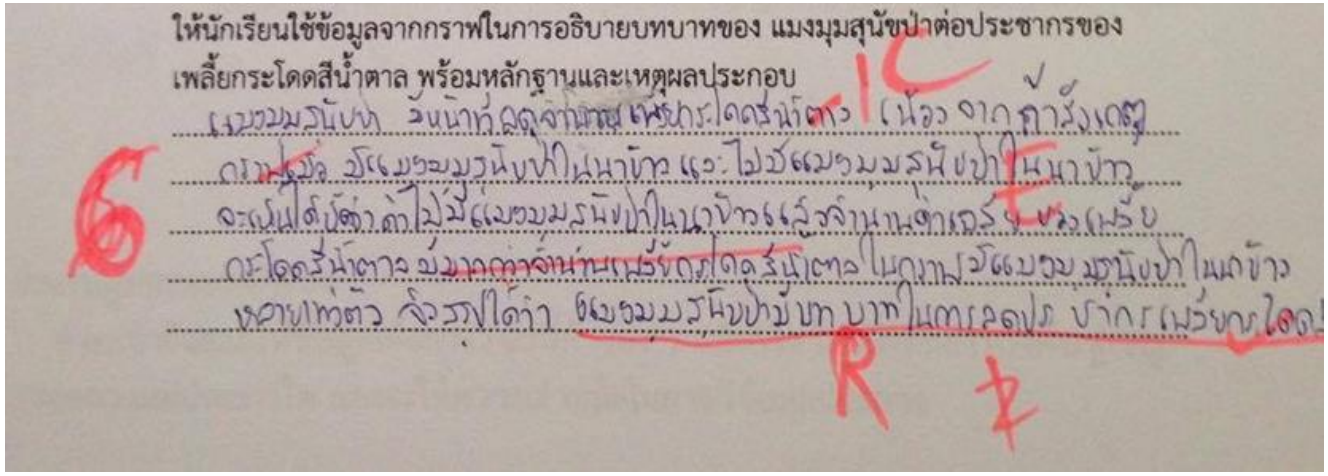


Claim and evidence





Claim, evidence and reasoning



Use the information in fig 3.2 to explain the advantages of using predators, such as hunting spiders to control brown plant hoppers with the evident and reasoning.

Student answer: When a cage predator open in the rice field , the hunting spider is brown plant hopper predator, Population of the brown plant hoppers are become lower and the evident is the graph decrease.

Conclusion and discussions

The findings suggest that most of the students

- Could make an accurate and complete claim.
- Faced difficulties in supporting the claims with evidence
- Could not provide reasoning that indicates connection between evidence and claim.

Conclusion and discussions

In general, most of the students could not write a good scientific explanation; agreeing with the previous research study.

The study also found that the students often used their previous experience or opinions to support their claims without using the evidence given in the prompt.

Conclusion and discussions

- science classrooms need to emphasize more on scaffolding students in the use of appropriate and supportive evidence as well as scientific reasoning when making conclusion from their investigations or even readings in order to enhance students' scientific explanation practice.

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The development of the inquiry cooperative learning incorporate with scaffolding scientific explanation activity, of the first author.