

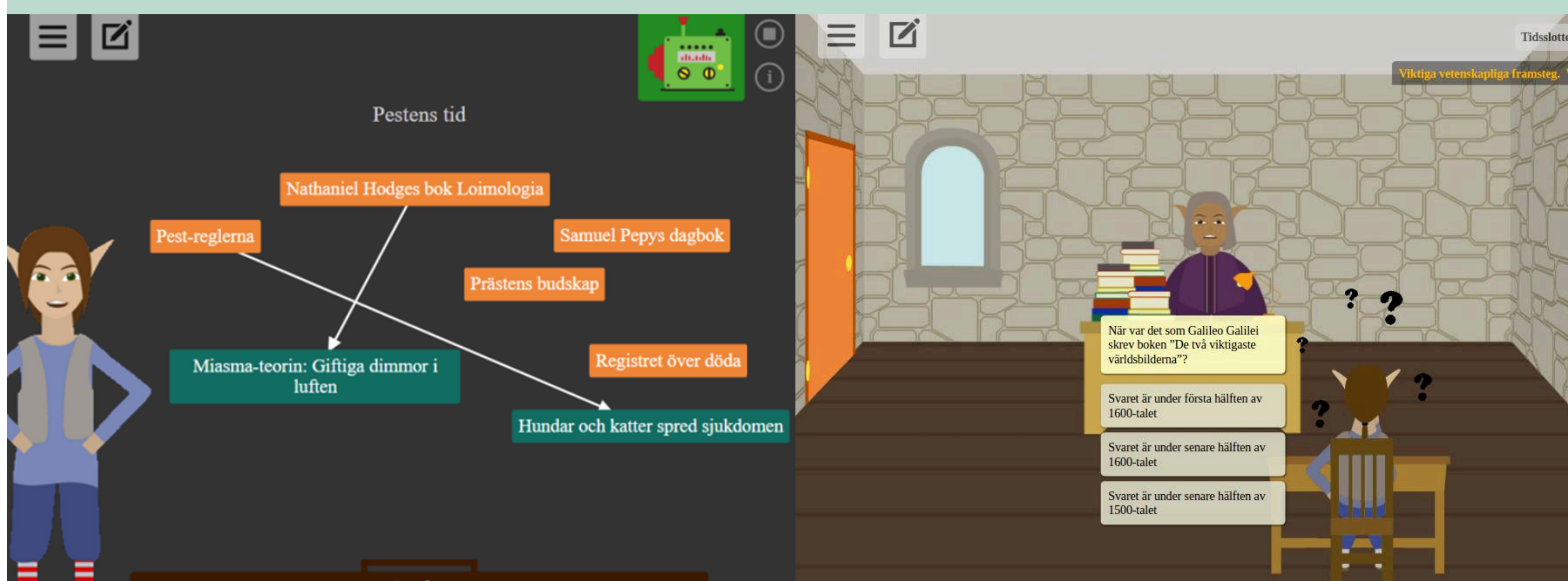
## Summary

- Two different learning algorithms for a teachable agent were tested with respect to perceived intelligence, protégé effect, and learning in Swedish grade 5 and 6 students.
- A strong positive correlation was found between perceived intelligence and protégé effect, but no significant differences were found between the two different implementations of the learning algorithm.
- The results suggest that while the perceived intelligence of the agent relates to the induced protégé effect, this perceived intelligence might not correspond to the implemented intelligence algorithm – something for designers of teachable agents to consider.

## Introduction

Studies have shown that the “teachable agent” paradigm, i.e. “learning-by-teaching” using teachable pedagogical agents in educational software, benefits learning by increasing students’ sense of responsibility and supporting metacognition. This effect, known as the “protégé effect”,

is a theoretical concept that describes the beneficial factors of the teachable agent paradigm in that the student makes larger learning efforts when the goal is to teach an agent than when the goal is to learn for themselves (Chase, Chin, Oppezzo & Schwartz, 2009).



## Experiment

**GUARDIANS OF HISTORY** is a teachable agent software aimed at middle school history education. The students are tasked with teaching the Time Elf about history by first visiting historical scenes and persons and thereafter teaching the agent in so-called “classroom activities”.

**TWO DIFFERENT ALGORITHMS** for the agent were used: a simple recency algorithm where the agent only “knows” the latest fact that it has been exposed to, and an associative learning model where the agent becomes gradually more certain of

facts and behaves accordingly in different situations.

**A QUESTIONNAIRE** and a knowledge test were used as measurement for protégé effect (adapted from: Kirkegaard, 2016), for perceived agent intelligence (adapted from: Bartneck et al., 2009), and for students’ knowledge gains.

**A SWEDISH SCHOOL** was contacted for the experiment and 94 5th and 6th graders from 5 classes were recruited.

## Results

- No significant differences between the two agent algorithms could be established.
- There was a strong correlation ( $r = .64$ ,  $p < .001$ ) between perceived intelligence and the protégé effect.
- No correlation was found between protégé effect and score on the knowledge test.

## Discussion

- The behavior of the agent did not affect how the students experienced it.
- The strong correlation between perceived intelligence and the protégé effect does, however, indicate that either there is an underlying cause or that they strengthen each other reciprocally. The underlying cause might however just be the students’ general attitude towards the agent or the setting.
- This correlation suggests that a teachable agent implementation should not focus (exclusively) on the learning algorithm of the agent.
- A lack of correlation between the protégé effect and the learning outcome suggests that further validation of the measurements should be undertaken.

## Further reading

### REFERENCES

- Bartneck, C., Kuli, D., & Croft, E. (2009). Measurement instruments for the anthropomorphism, animacy, likeability, perceived intelligence, and perceived safety of robots. *Int. J. of Social Robotics*, 1(1), 71-81.
- Chase, C., Chin, D. B., Oppezzo, M., & Schwartz, D. L. (2009). Teachable agents and the protégé effect: Increasing the effort towards learning. *J. of Science Education and Technology*, 18(4), 334-352.
- Kirkegaard, C., (2016). *Adding Challenge to a Teachable Agent in a Virtual Learning Environment*. Licentiate thesis, Linköping University, Sweden.