Can innovative learning applications influence the students' attitudes towards science: The case of digital games.

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Identifying the problem

- The classical method of teaching being used all these years doesn't get the students close to Science Technology Engineering Math (STEM).
- Although there might be some students that are interested in learning STEM, they soon change their mind because:
  - STEM is difficult
  - they can't connect what they learn with the real life
  - they learn how to solve highly complicated exercises but they really don't understand the true nature of science

(Teaching Physics: Figuring Out What Works. Redish, Edward F.; Steinberg, Richard N.,1999)

(What we teach and what is learned – Closing the gap, McDermott, American Journal of Physics 59, 301 (1991))

These have led us to:

- the growing shortage of researchers of natural sciences from the European market.
- creating a society that consists of more and more scientifically illiterate citizens.

- In our attempt to change this trend, we decided to use Digital Games Programming.

(*http://ec.europa.eu/research/index.cfm?pg=why&lg=en*)

What are we trying to achieve?

- To alter students' attitude towards STEM
- To enhance their problem solving skills
- To teach them how to cooperate
- To teach them how to follow instructions
- To enhance their creative thinking
- To engage them in programming
- To include them in STEM

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This can be achieved (hypothesis)

- Through the engagement with programming digital games

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Why Digital Games Programming?

- It enhances their problem solving techniques.
- It is easy for the teacher to use.
- It initiates students in programming.
- Students learn about STEM “without understanding that they are learning”.
- Students learn by inquiring.
- It gives them a strong motivation of creating something that their friends are going to play.

(Fowler, A., Fristoe, T., and MacLaurin, M. “Kodu Game Lab: A programming environment.” The Computer Games Journal, 1, 1 (2012):17-28)

(MacLaurin, M. B. (2009). Kodu: end-user programming and design for games. Paper presented at the 4th International Conference on Foundations of Digital Games (FDG 09), Orlando, Florida)

Inquiry learning

- We are using the learning by inquiry method in order to provide to the students:
  - initiation in the scientific research.
  - scientific skills acquired by exploration.
  - the joy of discovery and creation.

(Hackling, M. W. (1998). Working scientifically: Implementing and assessing open investigation work in science. Perth: Education Department of Western Australia)

Inquiry **continuum**

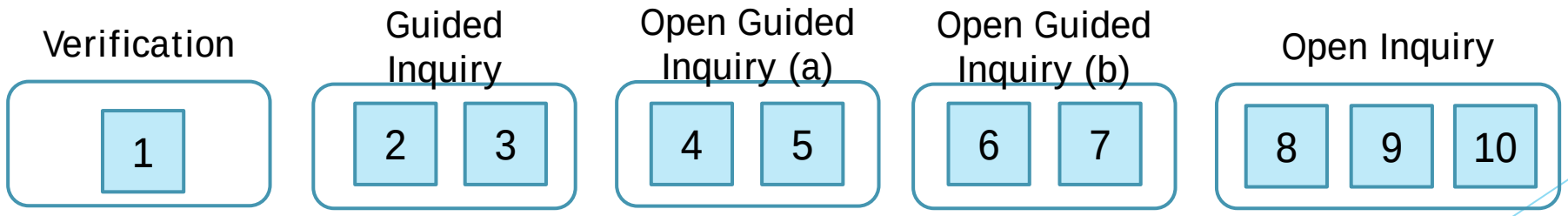
Levels of openness of inquiry in laboratory activities (according to Hegarty - Hazel, 1986)					
Level	**Problem**	**Equipment**	**Procedure**	**Answer**	**Common Name**
0	Given	Given	Given	Given	Verification
1	Given	Given	Given	Open	Guided Inquiry
2a	Given	Given	Open	Open	Open Guided Inquiry
2b	Given	Open	Open	Open	Open Guided Inquiry
3	Open	Open	Open	Open	Open Inquiry

Levels of openness of inquiry in programming digital games (according to our course)					
Level	**Game**	**Characters**	**Programming**	**Scenery**	**Common Name**
0	Given	Given	Given	Given	Verification
1	Given	Given	Given	Open	Guided Inquiry
2a	Given	Given	Open	Open	Open Guided Inquiry
2b	Given	Open	Open	Open	Open Guided Inquiry
3	Open	Open	Open	Open	Open Inquiry

Place and Sample

The implementation took place in Platon School of Katerini (private high school in Katerini – Greece)

- 31 students (17 boys and 14 girls) of the first class of high school took the course divided in groups of two one group of three.
- The course lasted 10 hours:



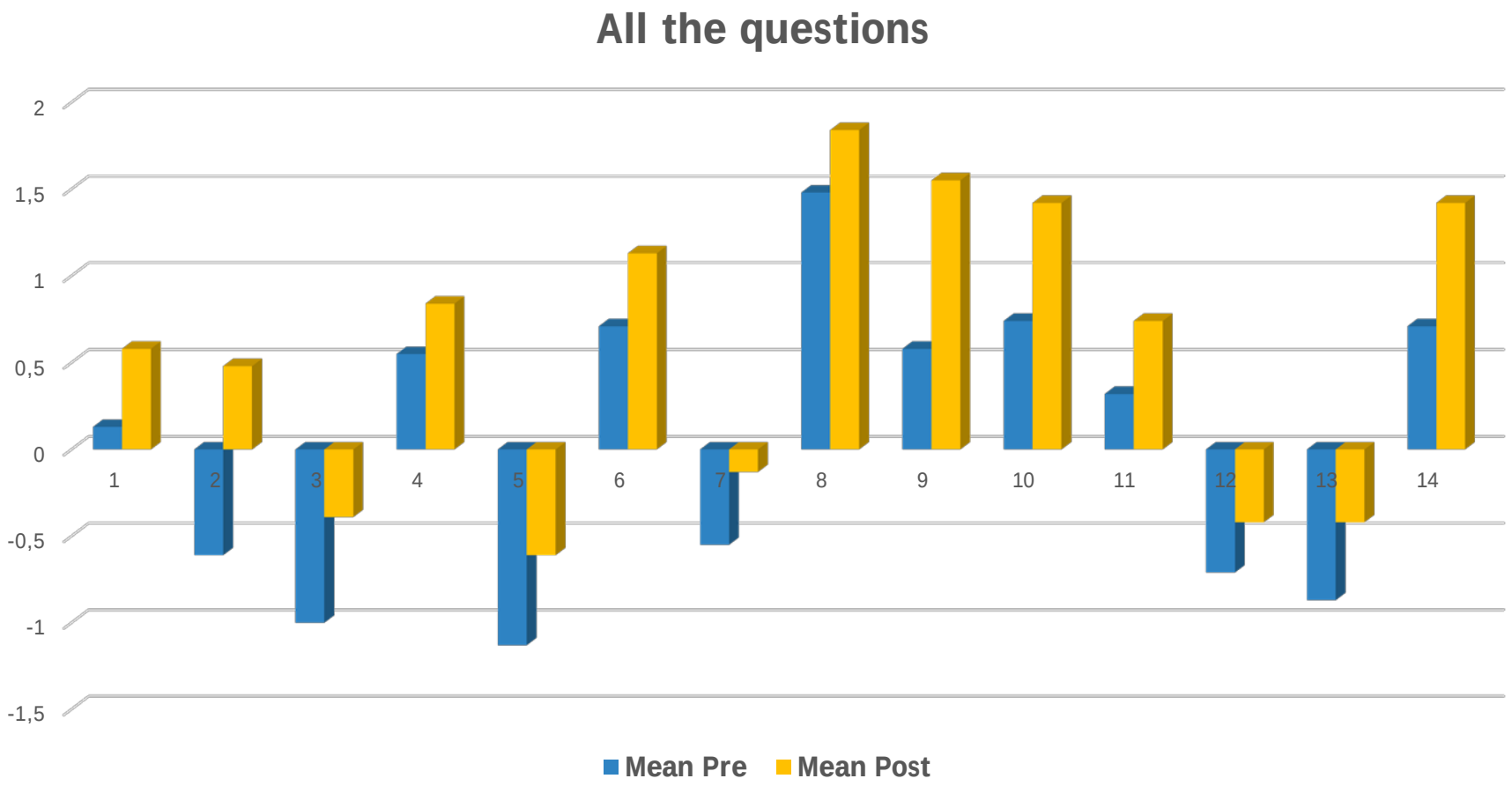
The tool we used: Kodu Game Lab

- The tool being used in our research is Kodu Game Lab Microsoft Software because:
  - It has been used in other researches providing good results.
  - It is easy to use (no codding needed).
  - The students can create the scene, the story, choose the heroes they like.
  - It has relatively nice graphics.
  - It is free.

Our research: The questionnaire

- Students answered a questionnaire about their attitudes towards STEM (pre-test)
- At the end of the course students answered the same questionnaire again to see if their attitude towards STEM altered in any way (post-test)
- The questionnaire consists of 7+14 questions (Likert scale) categorized in 5 categories which are:
  - 7 questions about themselves (gender, age, grade in physics, etc.)
  - 5 questions checking if the students are attracted to physics and math (Q1: I observe natural phenomena and try to learn why they happen, Q2: I read science book and articles, Q3: I would like to have a job that has to do with science, Q9: I like science, Q10: I like math)
  - 4 questions checking how students feel or react during class (Q5: I care about science class, Q6: I participate during science class, Q7: I feel nervous during science class, Q8: I would like to experiment more during science class)
  - 3 questions checking if the students consider STEM important (Q4: it is important for someone to know physics, Q11: I use what I learn in physics class in everyday life, Q13: I don't need physics)
  - 2 questions checking if the students think that STEM is easy (Q12: Science class is easy, Q14: Science is easy)

Results & Discussion



Results & Discussion

Category 2 (Q2: I read science book and articles)

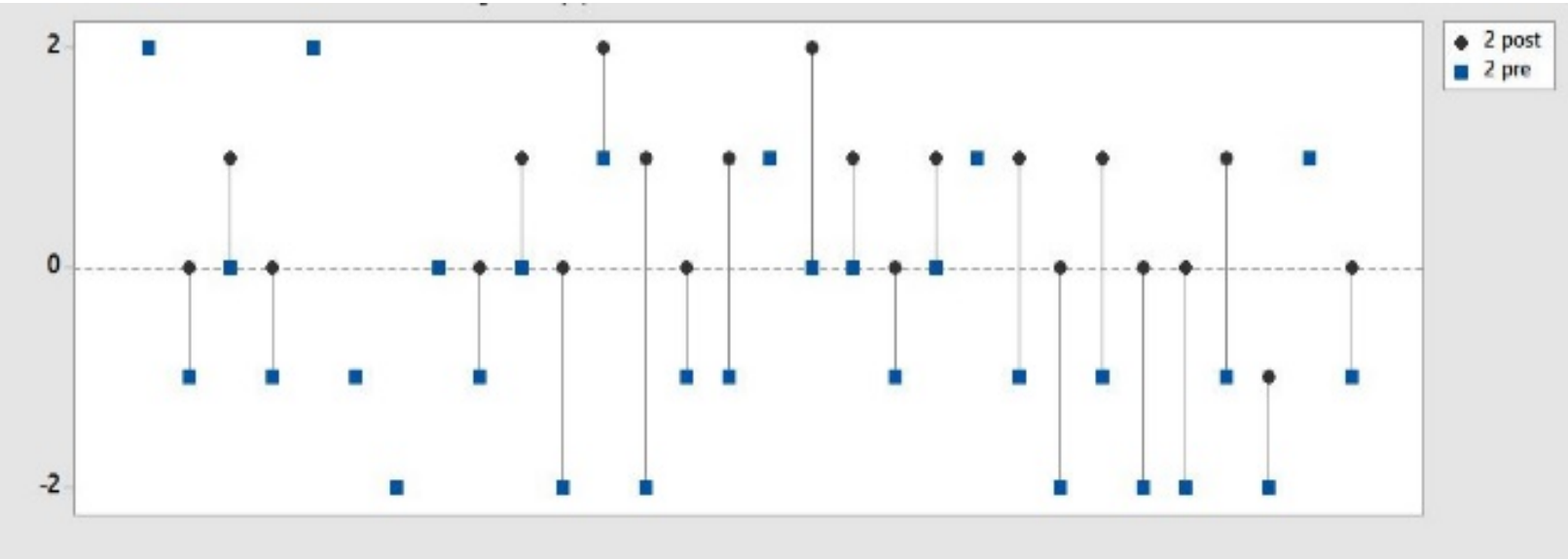


Figure 1: Q2 pre-post

($p<0.01$)

Results & Discussion

Category 3 (Q5: I care about science class)

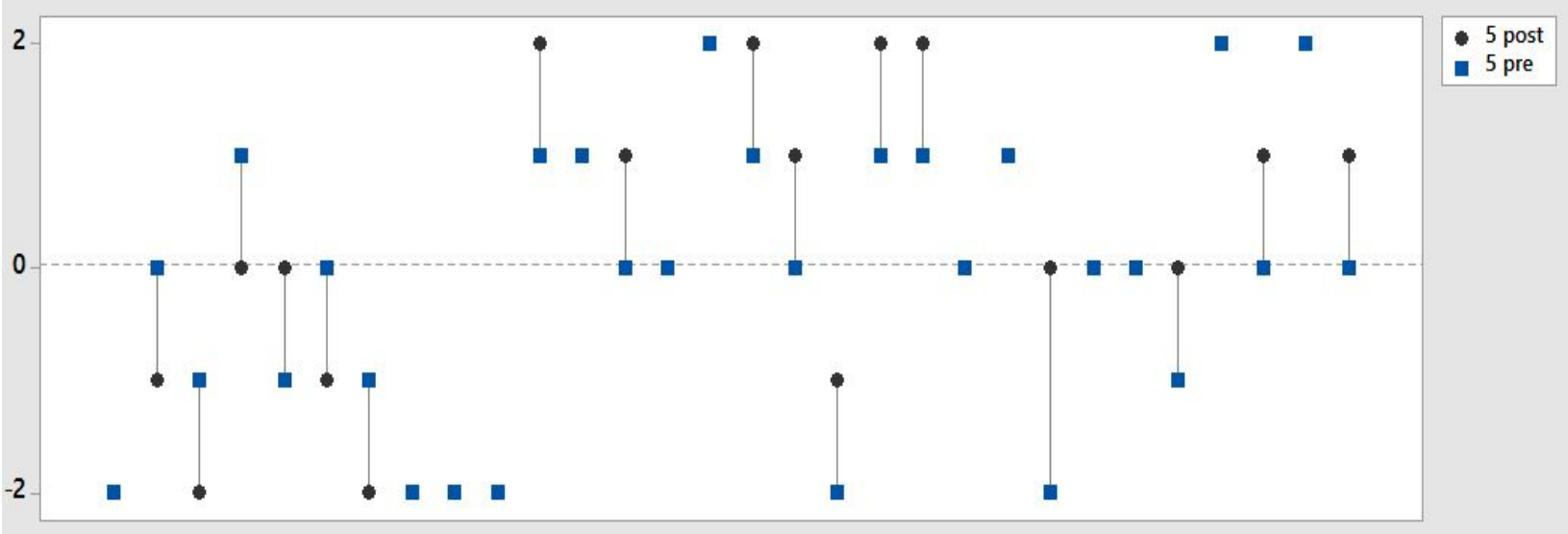


Figure 2: Q2 pre-post

(p=0,036<0,05)

Results & Discussion

Category 4 (Q11: I use what I learn in science class in everyday life)

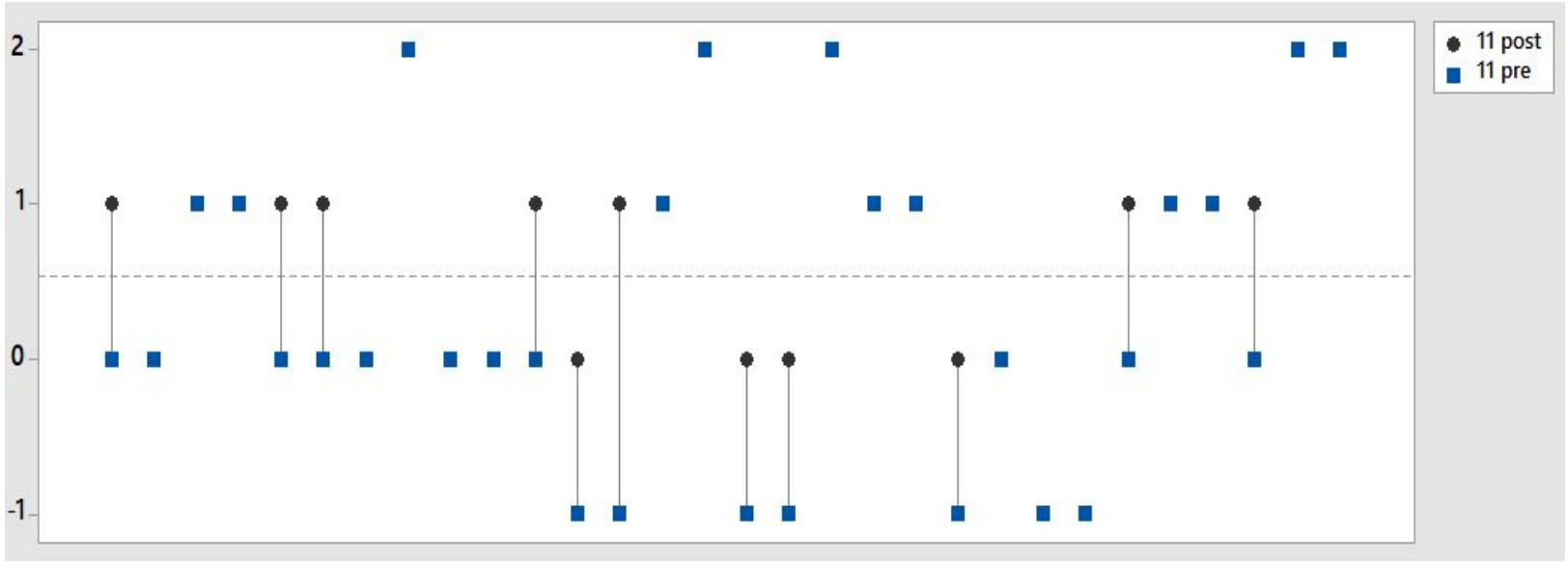


Figure 3: Q11 pre-post

($p<0.01$)

Results & Discussion

Category 5 (Q12: Science class is easy)

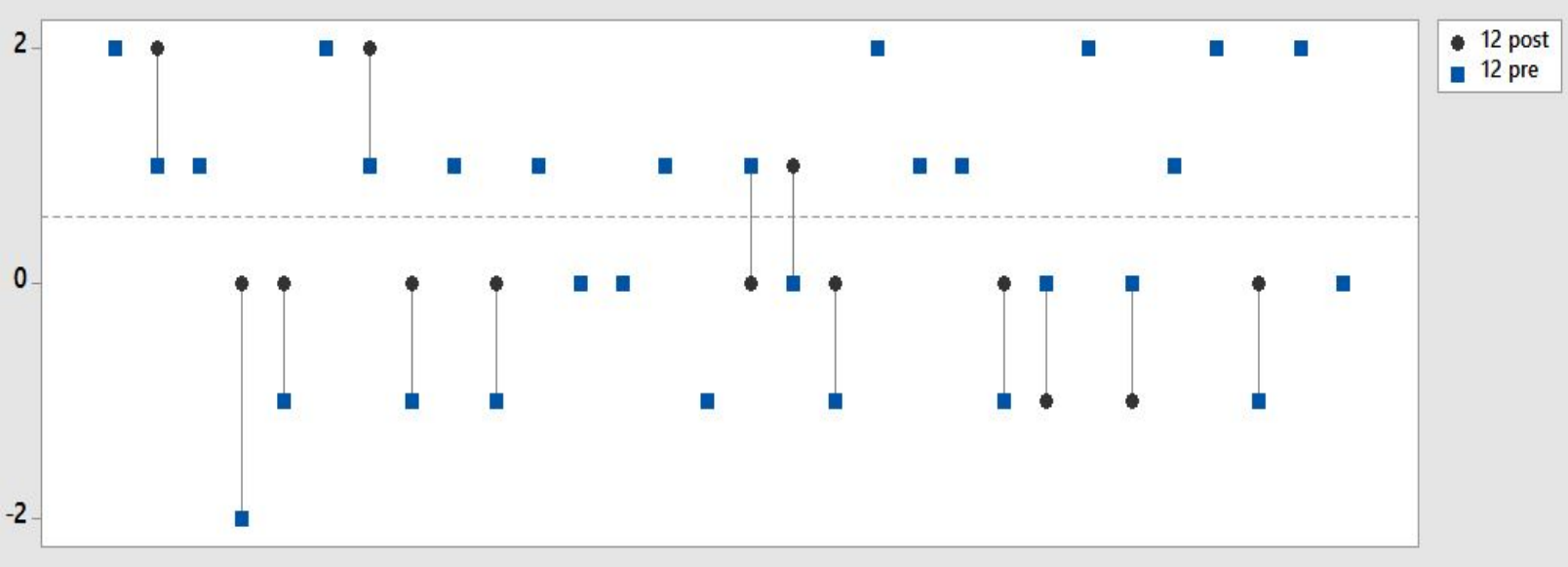


Figure 4: Q12 pre-post

(p<0.01)

Conclusion

- Students accepted the type of course.
- They have started to believe that STEM is not so difficult after all.
- Their attitude did change from being “indifferent” to being “good”.
- They have started to observe natural phenomena and try to learn why they happen more often than before.
- Encouraging results for us to continue the research.

Thank you very much