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))

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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.
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.


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.

### Inquiry continuum

#### Levels of openness of inquiry in laboratory activities

(according to Hegarty · Hazel, 1986)

<table>
<thead>
<tr>
<th>Level</th>
<th>Problem</th>
<th>Equipment</th>
<th>Procedure</th>
<th>Answer</th>
<th>Common Name</th>
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<td>Guided Inquiry</td>
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<td>Open Guided Inquiry</td>
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<tr>
<td>3</td>
<td>Open</td>
<td>Open</td>
<td>Open</td>
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<td>Open Inquiry</td>
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</table>

#### Levels of openness of inquiry in programming digital games

(according to our course)

<table>
<thead>
<tr>
<th>Level</th>
<th>Game</th>
<th>Characters</th>
<th>Programming</th>
<th>Scenery</th>
<th>Common Name</th>
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<th>New Perspectives in Science Education, Fifth edition, March 17-18 Florence</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Changing Students' Attitude towards STEM by Educational Robotics &amp; Digital Games Programming.&quot;</td>
</tr>
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</table>
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 or one group of three.
- The course lasted 10 hours:

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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 coding 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

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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)

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Category 5 (Q12: Science class is easy)

Figure 4: Q12 pre-post

(p<0.01)

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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