Evaluation of the Game Creator Tool and two Pilot Games

1. Introduction

For the Erasmus+ project "Create Digital Games for Education" (CDG4E), a Game Creator Tool was created that is to be used in classrooms for educational purposes. It is designed to enable teachers, as well as students, to create games for various curricular domains with a low-threshold approach. The basic game mechanics are predefined and didactic materials are provided which simplifies the game creation process considerably. The game design intends to stimulate a reflective exploration of a subject area. In the center of the game mechanics are decisions and their effects on "resources". In contrast to a classic quiz, the focus of the games is not about answering a question correctly or incorrectly. Rather, it is about dealing with the effects of one's own decisions. The primary target group are students between 16 and 18 years. Since the tool is built around a simple user interface (for easy onboarding) it can be applied in various educational settings and can be easily used by younger target groups. It allows teachers to stick to predefined learning goals but also offers the opportunity to address general topics of interest such as STEM related subjects as well as FAKE NEWS which were chosen as foci for this project.

The aim of the present study was to evaluate the impact of two pilot games developed by the project partners and of the Game Creator Tool, in terms of cognitive and motivational changes in students.

2. Methodology

Sample

The total sample size is N = 4 Teachers & N = 86 Students, the testing took place in Austria, Luxembourg as well as Malta in higher secondary schools.

In **Luxembourg** we performed the field testing in 2 classes in one secondary school in Luxembourg-City on two different days. On 14/01/2020 a class of 12th graders (section E: Plastic Arts; N1 = 12 students & 1 teacher; age: 17 years) participated and on 31/01/2020 a

class of 11th graders (section G: Human and Social Sciences; N2 = 24 students & 1 teacher, age: 16 years) participated. In **Malta** 2 classes participated with the first test taking place on 16/03/2020 and the second test taking place on 23/03/2020 (Computer Science; N = 24 students). In **Austria** the game was tested in 2 classes in Deutschlandsberg and Graz, Styria (Physics). The first testing took place on 11/02/2020 with 14 students participating, the second testing took place on 14/02/2020 with 12 students participating.
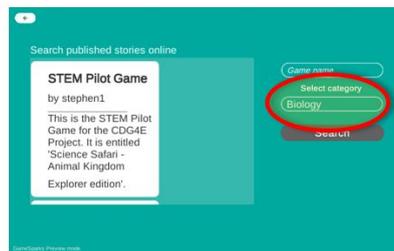
Procedure

Fig. 1: Introduction I

The field testing sessions started with greeting the students and their teacher and giving a general introduction to our Erasmus+ project, as well as some explanations about the objectives of the evaluation study.

Let's Game Design!
Ausprobieren des Game Creators

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- Sucht euch ein Team von zwei bis drei Personen!
- Wählt ein Thema über das ihr ein Spiel machen wollt. Ihr habt freie Wahl! ☺
- Bevor ihr startet, überlegt euch:
  - Was wollt ihr im Spiel vermitteln?
  - Was ist die Rolle der Spieler*innen? Von welcher Perspektive sollen die Entscheidungen gemacht werden?
  - Welche Ressourcen wollt ihr im Spiel haben?
  - Welche Aktionen können im Spiel gemacht werden? Welche Entscheidungen müssen die Spieler*innen treffen?
  - Wie sollen die Entscheidungen die verfügbaren Ressourcen beeinflussen?

Fig. 2: Introduction II

Then students were invited to play the two pilot games and then to do first attempts at creating a small game with the Game Creator Tool. Explanations were given about how to interact with the games, or how to use the Game Creator Tool.

Fig. 3: Testing in school class

Further explanations were given when students asked or when we saw that they got stuck in the process. The objective here was to see in how far the games and the creator tool were self-explaining.

Online Questionnaire

The online questionnaire was used to access the following aspects of the Game Creator Tool as well as of the two pilot games: usability, usefulness & learning opportunities, immersion/fun/interest, and impact.

For each statement participants (students and/or teachers) were presented with a *6-Point Likert Scale* which they could use to indicate to what degree they agreed/disagreed with them.

Usability (Teachers & Students)
1. The game creator allows me to do interesting things.
2. It is difficult to navigate within the game creator.
3. I can quickly find what I want.
4. The user interface seems logical to me.
5. The game creator needs more introductory instructions.
6. The individual screens of the game creator are appealing.
7. I feel that I am in control when using the game creator.
8. The game creator is too slow.
9. This user interface helps me to find what I am looking for.
10. Orientation in the game creator is difficult to learn.
11. I do not like using the game creator.
12. When I use the game creator, I have the feeling that I am efficient.
13. This game creator is easy to use for the first time.
14. This game creator has some annoying features.
15. When I query certain submenus in the game creator, I get what I expect.
16. The whole game creator is easy to understand.

Usefulness + Learning opportunities (Teachers)
Having a tool to create educational games for or with my students...
1. would improve my performance as a teacher
2. would increase my teaching productivity
3. would enhance my effectiveness as a teacher
4. would improve my popularity as a teacher with students
5. would improve my prestige as a teacher among other teachers
6. would help my students to achieve better grades
7. would make my teaching more engaging to my students
8. would help my teaching to be more meaningful to my students
9. would make my students be more self directed learners

10. would stimulate transfer of knowledge between various subjects
11. would make my students' learning deeper
12. would allow my students to interact more with other students
13. would improve my students critical thinking skills
14. would motivate my students to learn
15. would make my students' learning more authentic

Immersion/Fun/Interest (Students)
Please rate the game creator by answering the following questions:
1. I think that the games which I created could be used for teaching a certain subject.
2. I tried to do well at creating games.
3. Creating games with the creator was fun.
4. It was important to me to do well at creating games.
5. I put a lot of effort into the game creation process.

Please rate the pilot games by answering the following questions:
1. I believe learning about STEM related topics could be beneficial to me (for a future profession).
2. I would describe the idea of learning about FAKE NEWS as exciting.
3. I would describe the STEM game as fun to play.
4. I am interested in STEM education.
5. I understand the importance of media literacy (the ability to create new media, to analyze as well as to evaluate media).
6. I really liked the FAKE NEWS game.

Impact (Students)
In STEM subjects (Science, Math, Engineering and Technology)...
In subjects where media (literacy) was addressed...

(Motivation)
...the learning/working was really fun.

(Interest)
...I was curious/interested.

(Competence)
... I felt personally encouraged.

(Comprehension)
… I had a good understanding of the topic.

(Autonomy) .
...I felt like I can make my own decisions.

(Active participation)
… I actively participated in the learning activities.

(Fun)
...I was looking forward to physics lessons.

3. Results

In this section we will report on qualitative and quantitative data gathered during the field tests. The method applied relied on a post-test. Quantitative multiple choice items (5 point likert scale) & open questions (content analysis) were part of the online survey. In total 4 teachers & 86 students participated. As an instruction standardized GDPR compliant privacy statements as well as an introduction into the 2 pilot games were given out.

On one hand we have non-systematic observations of how the students interacted with the two pilot games and the Game Creator Tool and on the other hand we have their responses to the survey measuring the usability of the creator as well as the pilot games and the impact on motivational variables as well as potential subjective knowledge gains.

Non-systematic observations
- Non-guided discovery of games and the Game Creator Tool was generally feasible, but the use of the Game Creator Tool was not totally self-explanatory. With minimal minimal guidance, students were able to then use it decently.
- Students need to be given a meaningful task when using the Game Creator Tool, otherwise they tend to produce simple multiple choice quizzes that could be used to test memory retention of basic facts.

- Framing and didactic guidance, reference to curriculum is helpful but relation to pupils' interests is key.
- Informal competences are addressed such as language learning in an incidental way, when unknown words are encountered in existing games.
- Reference to key competences such as communication, collaboration, creativity and critical thinking can be made.

- The game creation process itself is curiosity provoking.
- The use of the Game Creator Tool should be embedded in project-related work.

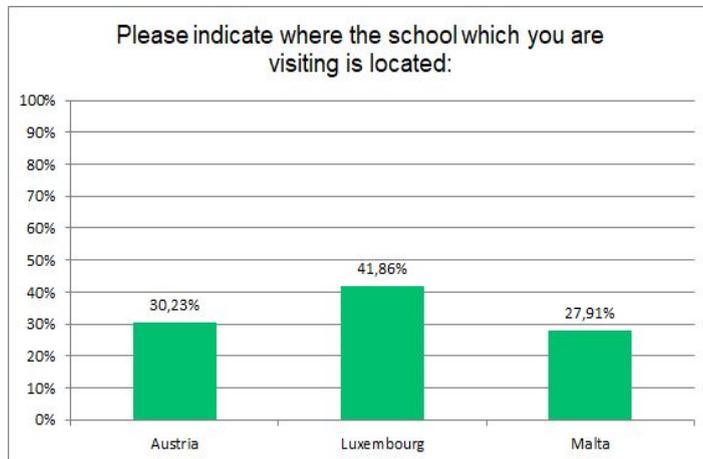## Quantitative & qualitative results - STUDENTS

Fig. 4: Participating countries

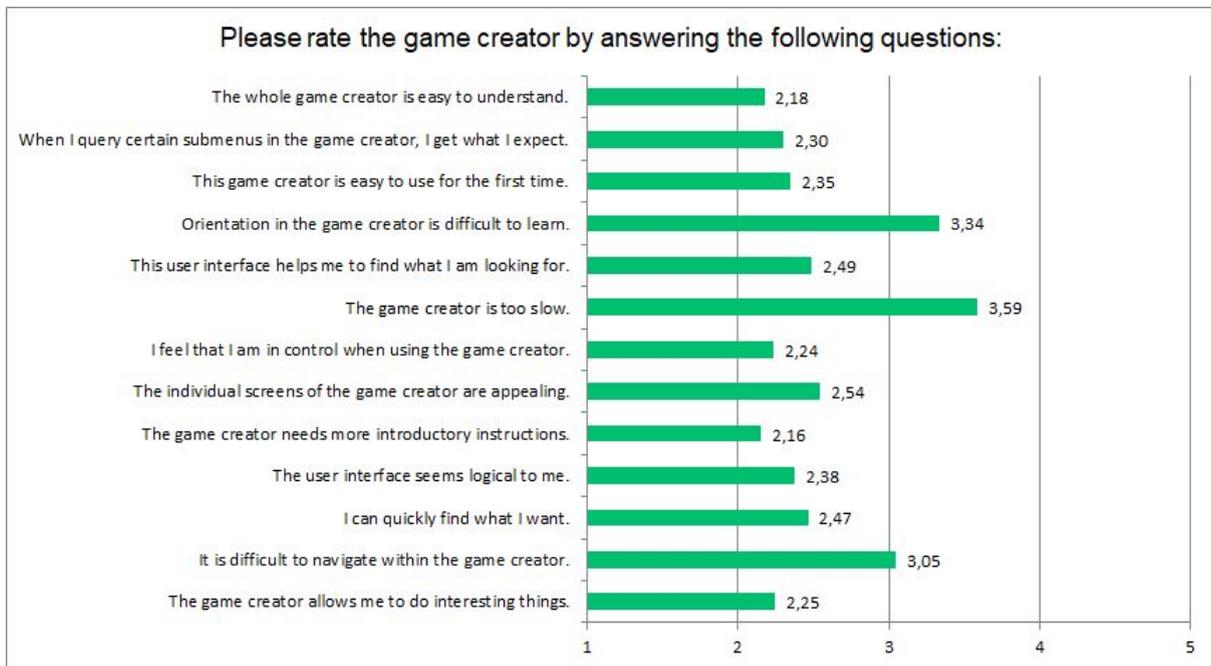Most of the students participating in the evaluation came from Luxembourg (N=38 students).

Fig. 5: Rating of the Creator Tool I: low values are equal to a high level of agreement

The overall rating of the Game Creator Tool was good with means ranging from 2,16 to 3,59. Critical remarks referred to the navigation within the Game Creator as well as the overall usability when using the Game Creator for the first time.
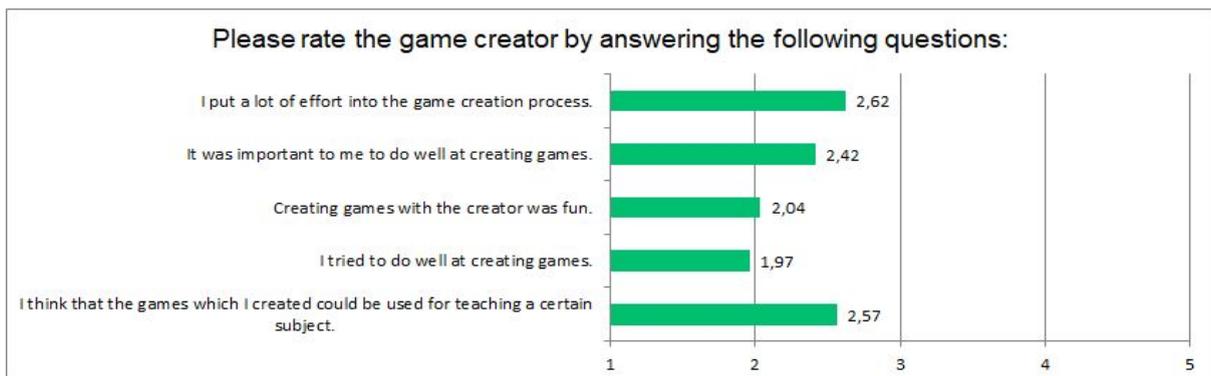

Fig. 6: Rating of the Creator Tool II: low values are equal to a high level of agreement

The game creation process itself was perceived positively with high values reported for motivational engagement and interest in reference to the games created.
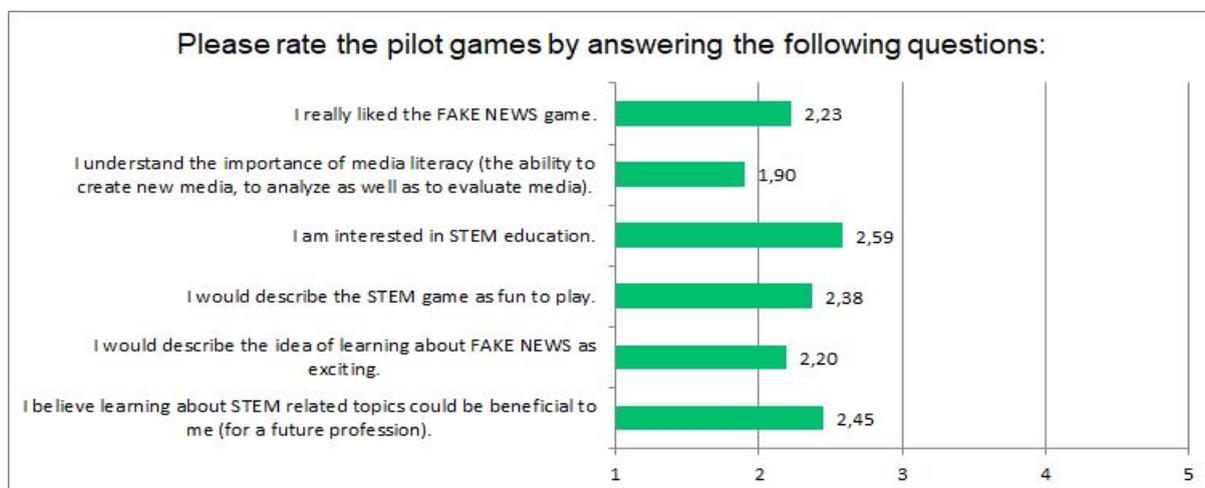
Fig. 7: Rating of the pilot games: low values are equal to a high level of agreement

The pilot games (FAKE NEWS & STEM games) were also received well within the target group with means ranging from 1,90 to 2,59 on the 5 point likert scale. Media literacy is seen as important competence (M=1,90) while STEM related subjects are seen as quite relevant for future professions.
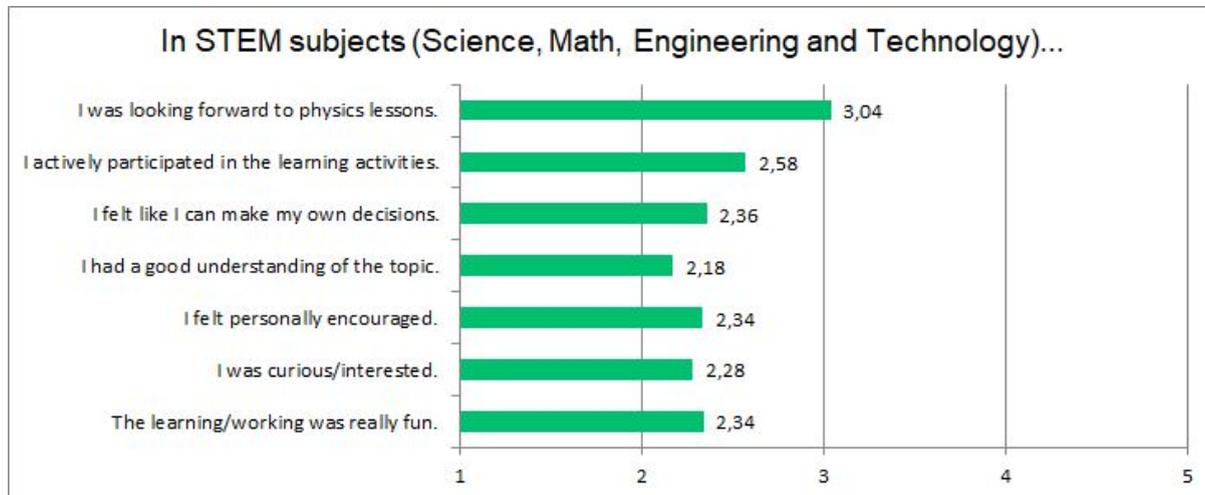

Fig. 8: Impact on motivational engagement in STEM: low values are equal to a high level of agreement

The motivational engagement in STEM related subjects is high with most values staying below 2,5 although students were not particularly looking forward to physics lessons.
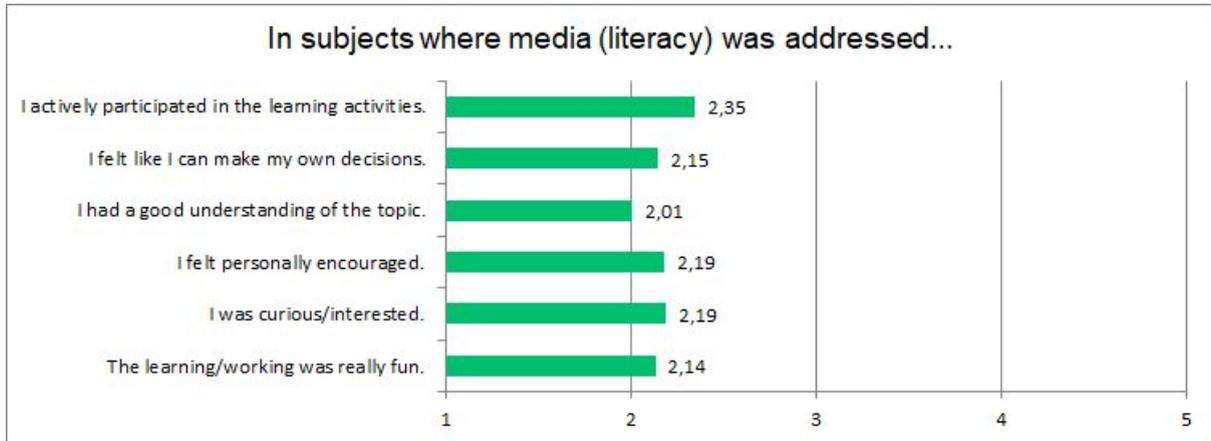
Fig. 9: Impact on motivational engagement in relation to media literacy: low values are equal to a high level of agreement

There is a high level of reported interest for subjects where media literacy was addressed with means ranging from 2,01 to 2,35. Students stated that they now have a good understanding of the topic after playing the FAKE NEWS game (M=2,01).
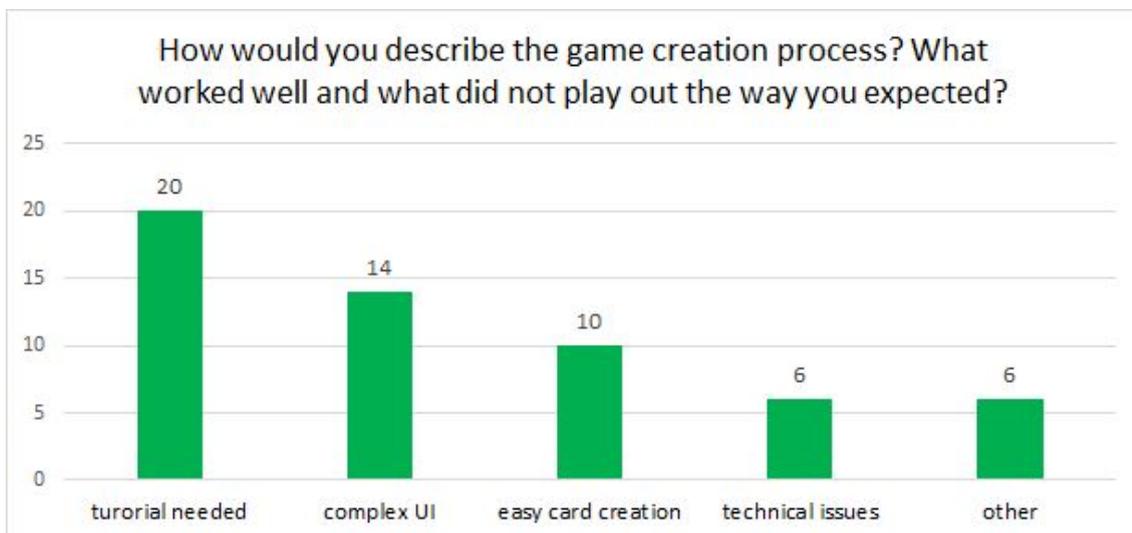

Fig. 10: Feedback on the game creation process

The content analysis for the first open question shows that a tutorial is highly needed because of the complex user interface - especially for first time users. The tutorial was implemented after the evaluation and is accessible via the Game Creator Tool.

Fig. 11: Rating of the pilot games
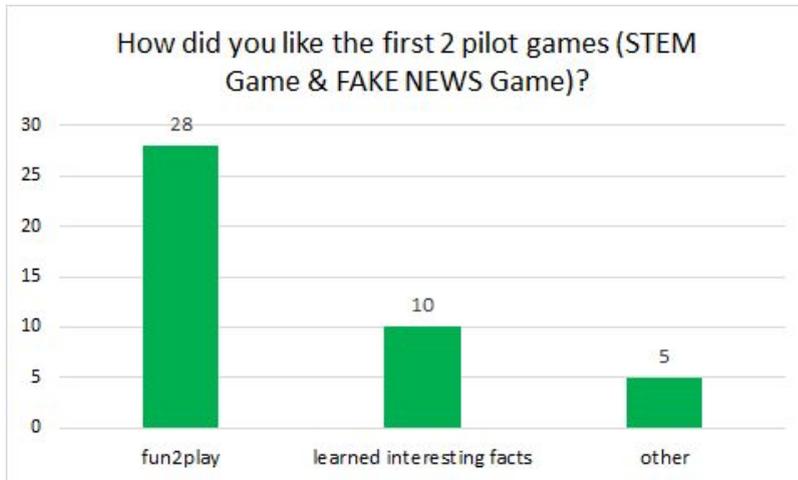
The FAKE NEWS game and the STEM game were fun according to the target group. 10 students stated that they learned interesting facts while playing the games.
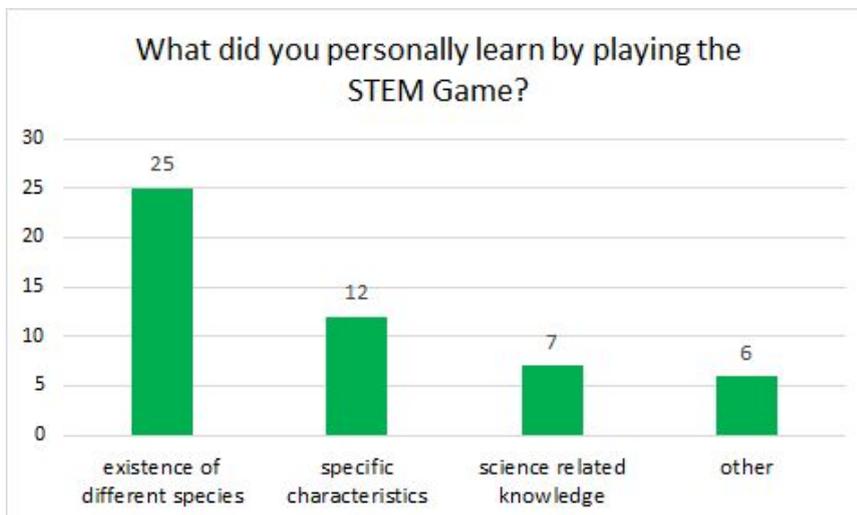

Fig. 12: Impact on knowledge through the STEM game

In relation to the STEM game students stated that they learned about the existence of different species and specific characteristics as well as science related facts in general.
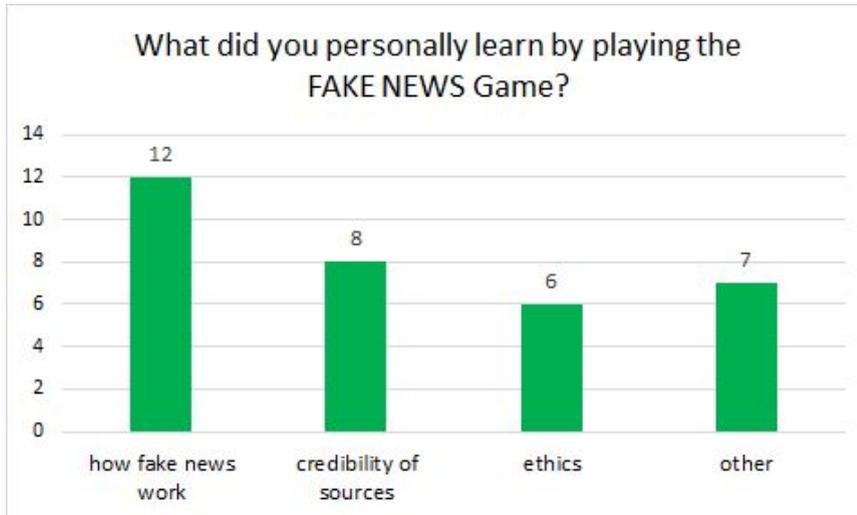
Fig. 13: Impact on knowledge through the FAKE NEWS game

In relation to the FAKE NEWS game students mentioned that they learned about the mechanics of fake news, the importance of credibility as well as ethical aspects.

Quantitative & qualitative results - TEACHERS

In total 4 teachers participated in the survey. All of them teached STEM related subjects, while 75% stated that FAKE NEWS were addressed at least once in their classes.

Regarding the usability, most of the remarks addressed the user interface "*If the user interface of the whole platform is improved I would consider using such a tool*" and the game creation process "*More time could have been invested in creating the game*".

Regarding the pedagogical potential teachers stated that the games are "*Interesting and motivating, whether to stimulate discussion (Fake News) or to acquire knowledge (Science Safari)*."

Please rate the game creator by answering the following questions:

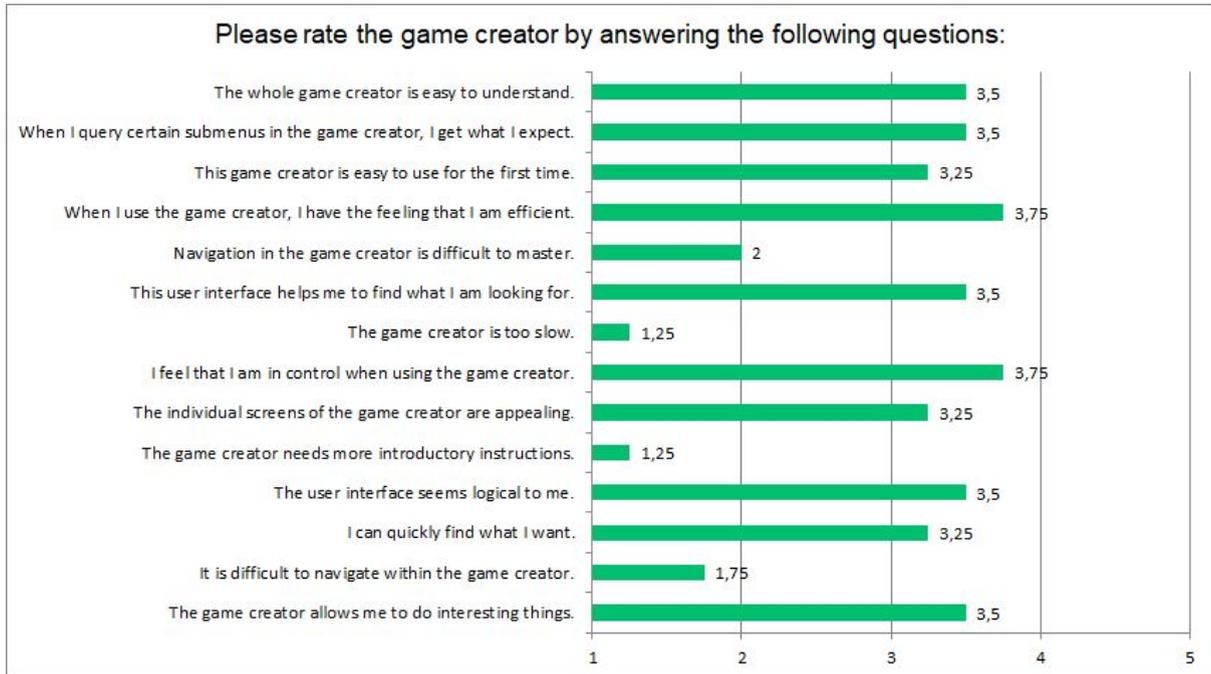| Question	Rating
The whole game creator is easy to understand.	3,5
When I query certain submenus in the game creator, I get what I expect.	3,5
This game creator is easy to use for the first time.	3,25
When I use the game creator, I have the feeling that I am efficient.	3,75
Navigation in the game creator is difficult to master.	2
This user interface helps me to find what I am looking for.	3,5
The game creator is too slow.	1,25
I feel that I am in control when using the game creator.	3,75
The individual screens of the game creator are appealing.	3,25
The game creator needs more introductory instructions.	1,25
The user interface seems logical to me.	3,5
I can quickly find what I want.	3,25
It is difficult to navigate within the game creator.	1,75
The game creator allows me to do interesting things.	3,5

Fig. 14: Rating of the Game Creator: low values are equal to a high level of agreement

The overall rating of the Game Creator Tool is critical in comparison to the target group students. Especially usability related aspects give room for improvements. Parts of the issues mentioned have already been fixed, a tutorial is provided.
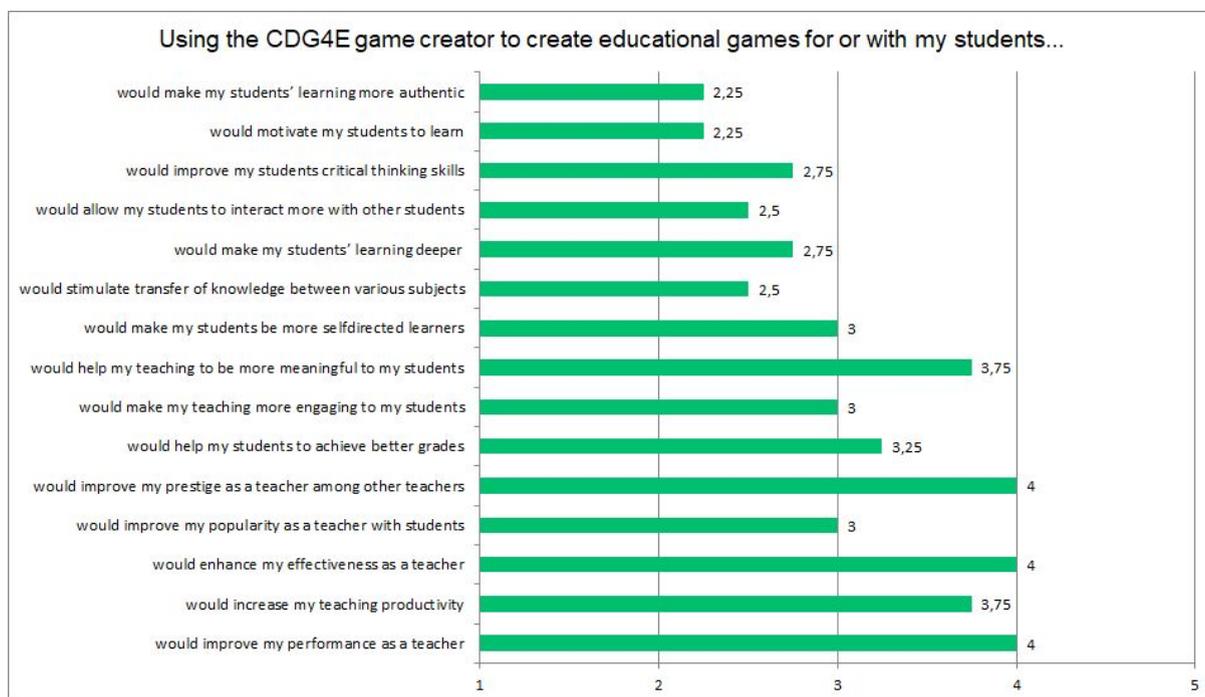
Fig. 15: Pedagogical potential: low values are equal to a high level of agreement

A similar picture arises when analyzing the pedagogical potential of the Game Creator Tool. While teachers see the positive impact on students' motivation, engagement and interest, they do not see the practical use case for their daily teaching practice.

4. Recommendations

Based on Robyler & Doering's (2013) distinction between educational technology integration strategies, namely using ICT to support directed instruction or to support inquiry-based learning, we can distinguish here between two main pedagogically meaningful uses of the Game Creator Tool and the games that can be produced with it. Students can learn by playing games or by creating games. It is also possible to combine these two approaches: first play a game, uncover the implemented mechanics and causal relations, then evaluate them against a realistic model of the phenomenon at hand and finally revise or expand the game for it to become a better model of the studied phenomenon.

While playing games they can actively engage with a learning situation created by their teacher (or another student) where some phenomena are discoverable. When creating, extending or revising a game themselves they are required to show their own understanding of some real-world or imaginary phenomenon and apply that to construct a digital artefact that others can interact with.

2a) Modelling a real world phenomenon - The games that are created by students, individually or collaboratively, act as products by which students show their more or less deep knowledge and understanding of a given phenomenon. They also act as an occasion to do thorough bibliographic and/or empirical research about it. Students try to find information about a certain topic and need to develop a good enough understanding of the underlying relationships, mechanisms and processes in order to be able to construct a game that feels realistic enough for experts. They thus need to build a model of the phenomenon which they use to develop the game.

2b) Modelling an imaginary world phenomenon - Students can also design games where they implement models of imaginary world phenomena, more or less inspired by real-world phenomena.

2c) Learning by Playing and then Creating / Revising - Students play a game that was developed by a teacher or other students which contains, on purpose or because of limited knowledge and understanding, more or less obvious shortcoming in modeling a real-world phenomenon. Their task is to get acquainted with the game and its underlying model, then to uncover its shortcomings and finally to edit the game in order to address these shortcomings.

5. Summary & Conclusion

Overall, the results of our study show that the Game Creator Tool as well as the FAKE NEWS game and the STEM game were well received by students. Both games were able to spark interest in respective subjects, students learned about different species and the importance of media literacy.

The teachers addressed in the survey delivered some critical remarks on the usability of the Game Creator Tool. The complexity of the user interface needs to be reduced, a first step was already taken into account with the creation of a video tutorial, which is now accessible via the Game Creator Tool menu.

The pedagogical potential is not yet seen by teachers, although it was stated that authentic and interesting learning environments can be built using the tool. More time and specific training is needed to use the Game Creator Tool for creating games by introducing dedicated project weeks.