

# JOURNEY TO MARS: ROLE PLAYING GAME EXPERIENCE IN AN ASTRONOMY CLASSROOM

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## Abstract

It is presented a report of an extracurricular course of Astronomy, performed in a Brazilian extracurricular school, making use of Role Playing Games (RPG) implementation in classroom, based on theoretical Physics and Astronomy contents. During four months, six private school students (ages 13-16) had Astronomy classes with the Journey to Mars theme. Students had to experience how they could plant on Mars, to construct and after to launch their rocket, to perform Spatial Physics, Mechanics and Astronautics calculations. In this work it is presented the specific story "Journey to Mars" in details, with the soundtrack used, how much time had been spent with each scene, and other useful issues; and the reactions of students and teacher are also presented. The results, obtained by the constructivism perspective, indicates good engagement by the students, as well the achievement of effective learning. This is an unabridged RPG report that can be adapted and replicated in other scholar contexts.

Keywords: Active learning, effective learning, astronomy education.

## 1 INTRODUCTION

On these days, it is necessary to promote different types of teaching methodologies at school. The students have to be prepared to face a hard job market. It is necessary to put the student not as a receiver, but as a builder of his on knowledge.

Is it showed [1] that the most important abilities today are the resolution of problems, flexibility, motivation for excellence, creativity, and others. Aiming to promote these abilities, it is necessary that students know how to work in teams, to analyse, to interact with each other and to criticize. To achieve it, it is necessary to think in active methodologies of teaching, and one proposal of this type of teaching and consequently a significant learning is the use of RPG (Role Playing Game) on school.

RPG is a type of game in which the actors take on roles of characters and create narratives collaboratively. The progress of a game is achieved according to a predetermined rule system, within which players can improvise freely. The players' choices determine the direction the game will take. RPGs are typically more collaborative and social than competitive. An RPG occasionally has winners or losers, fueling the imagination, without however limiting the player's behavior to a particular plot. The RPG is a traditional story-telling game, in which there is a master, who plan and control the adventure (the teacher), a scenario, characters (the students) who help to construct the narrative, using improvisation and previous knowledge about the theme treated [2]. There are specifics rules and tokens from the original game to define the characters on the traditional game that can be adapted to teaching.

This a good type of methodology to make students think and talk without fear in front of others, a good cooperative work.

According to Vygotsky, the cognitive development depends on the social medium, in other words, the individual learn as he or she interacts with the social. Besides that, Vygotsky [3] also defend that the child learn with the play, the game provides the necessary to it.

The RPG is also a good kind of evaluation, where the teacher and perfectly perceive if the student have learned the contents on class. Also, the teacher can introduce new contents during the game.

Therefore, we have done use of this practice in our class in order to perceive some of these expected results. Accordingly, we believe that using these practices, the teaching and the learning can be improved.

## 2 METHODOLOGY

In this work, we applied the game to a class of six students, who had four months of Astronomy extracurricular classes, with different types of active methodologies. To finish the course, it was applied the RPG to review, evaluate and also to teach new contents to them.

The teacher can evaluate the students by observing what they talk during the game, the proposed strategies by them, the critics to the other's ideas, their way of thinking, and the application of previous knowledge to get out of an unusual situation. The teacher can take notes of these talks or can record it.

The further analysis also depends of the teacher and for what he wants it.

Here we present the adventure complete with instructions to the teacher of how to perform it on class, including the necessary time for each scene and a suggestion of sound track to help students to emerge in the adventure.

Initially, the teacher gives the tokens to the students (adapted to the teaching). The participants choose their characters, they distribute the point they have in some abilities and after that, they enter on the adventure, commanded by teacher, but having power of decision to change the story any moment they want to.

### 2.1 The adventure: Journey to Mars, step by step

The mission proposed by the narrator was to go to Mars, establish a shelter for recognition of territory and return to Earth. Initially, the teacher should help the students to make the tokens for their characters, according to the traditional game, but in a simplified way.

The traditional game's classes of the characters should be replaced by some contextualized with the adventure, like engineer, doctor, military, astrophysicist, etc. There are six players in this experience (time of this stage: 30 min).

From this moment, the teacher may put an adventure soundtrack that refers to space travel and achievements (it is important to know all the music initially to synchronize it with the adventure). The suggestion is a song of at least 1h30 in duration, so that it doesn't stops in the middle of the game. To start the adventure, introduce students to the virtual reality (VR) inside a spacecraft (available in Google for Education) [4] (time: 5 min).

Teacher: "To start this adventure, let's go back to the rocket you have built last week (students built and launched PET rockets) and let's play the rocket runner's VR game" (available on Youtube) [5]. Here students can imagine themselves actually travelling in a spacecraft.

Teacher: "Now that you're out of Earth's atmosphere, you're in the 'cruise flight' phase to Mars, it's all quiet" (time: 10 min).

At this point the teacher launches a problem inside the spacecraft: a siren deafening sound.

Teacher: "What's that noise? What's going on?" (PS: do not turn off the noise until the problem is solved).

Here the students interact with each other, and the teacher alerts to the red flashing emergency button in the control room.

One of the rockets fired alone, diverting them from the original route, passing by Mars, but unable to land. The attraction of Mars, along with the shot, causes a effect that sent them to the Asteroid Belt, beyond the red planet (time: 10 min).

At this point, show them the Solar System's VR (in Google for Education) [4], where the photo shows how students are among the asteroids (Put a suspense soundtrack until the problem is solved.)

At this phase, students interact proposing solutions to resume the route and they count on the luck to return to Mars.

It should be remembered that the craft had a charge 6 of fuel, and with each forced maneuver, 1 tank is spent additionally; students should take these expenses into account when thinking about strategies for returning to Mars. Depending on students' reasoning and ideas, the teacher stipulates the required number of points to roll the dice. For example, if it's a bright idea, few points are needed for the action

to be completed successfully. If the ideas are not good, you can make them lose more fuel, move away from the route, this is at the teacher's discretion (time: 10 min).

The moment arrives for the arrival to Mars, and the teacher speaks (suspense music): "Guys, what is going on? The spacecraft is not slowing down, you are getting faster and faster towards the planet! What you are going to do? You need to solve this problem and you have 20 seconds until the fall, from now on! "Students are expected to interact by recalling the concepts of previous classes regarding free fall and air resistance (time: 10 min). According on their actions, it will be the damage done to the spacecraft.

Teacher (return to the original soundtrack): "Ok, now you start to leave the spacecraft, all broken, which will need great repairs. Look around the surface of Mars" (show the VR, available in Google for Education) [4]. While they observe the image, speak some characteristics of Mars, like atmosphere, temperature, and surface (time: 10 min).

Teacher: "Okay guys, now you're exploring the area, you realize that the sun is going down in a few hours, and you need to find some place to set up camp, a base. Ok, you already have seen the landscape, where will you set up the base? Suggestions? "This part depends on the students' interactions and their strategies. Make sure that they divide the tasks for building the base (time: 10 min).

Teacher (sandstorm soundtrack): "You have set up the base, went to sleep, and suddenly wake up frightened by a huge Martian storm that causes a huge noise in the area where the spacecraft is. Do you get up to see what it is? Ignore it? What is happening? "There will be the interaction of each one of the students.

Teacher: "Well, it was not exactly a sandstorm; actually the earth was moved due to the landing of another space vehicle, black matte, triangular shape with a bright semi-sphere in the middle, which looks like a window. Inside, they see two apparently humanoid guys, wearing black cloaks that cover their faces, analyzing your spacecraft. And what about now? Do you let them go away? Do you attack them? Do you start to run? Do you try to make any contact? What do you guys do? If you let them go, they will go to your spacecraft and take it with them". In that case, students will have to stop them, otherwise they will not leave the planet; you teacher have to make them stop the humanoids. It may be that they decide to fight to the strangers, the teacher must predict this. They can improvise weapons with scientific equipments. The strangers do not have guns, but they're great at fighting. Attention: No way, no one can remove the black cloak from the subjects' heads to see their faces. Will they be martian looters? The teacher can not reveal their identity so he/she has an alibi for the next adventure; so the teacher can take the story to the direction he/she wants to. At the end of this block (return to the original soundtrack), the looters take parts of the ship with them and escape with their spacecraft. Here the teacher should use his/her resourcefulness and not let the students escape from the script (time: 15 min) (return the original song).

Teacher: "Unfortunately folks, you'll have to build a new ship to leave. And these guys, who were they? Martians? Extramartians? Or a kind of illusion, or dream that you had because of the rarefied atmosphere? Who knows!? Take a look at the starry sky (VR in Google for Education) [4], contemplate this wonder and try to see the Earth, so far, so tiny! Will you ever get home? Go back to sleep at the base, tomorrow you will build a new spacecraft to take you home. Oh, remember that this new spacecraft has to have artefacts to deal with Earth gravity" (maybe a ship with the parachute at the top what do you think about it?) (In the next class the students would build a PET bottle rocket with parachute, so it was important to induce them to think about it) (time: 10 min)

Teacher: "After much work on the spacecraft, after being stolen by galactic looters, the young adventurers on Mars are preparing themselves to return to their beautiful Earth. The spacecraft is ready and you are now preparing for take-off. Take one last look at Mars (VR in Google for Education) [4]. Now you enter in the new spacecraft, and you get in touch with Commander X (the teacher's name), who is on Earth, and you should ask, 'All right for our take-off, sir commander?', to which the commander responds positively."

Teacher: "Let's see if the commander's response was true, he/she may not have noticed any flaws: If the spacecraft is okay, you need to take 15 (points of the dice + character intelligence), since it's a very difficult task to put a spacecraft out of the planet. If you take less ... we'll see what happens!" In this case, the spacecraft will lose half of the water supply, and they will have to deal with it (small plot that depends on the interaction of the students), and will arrive very dehydrated on Earth.

Teacher: "Okay, the landing day comes in. You can get into the atmosphere without getting burned, but what happens if you get off without a parachute? Do you remember the previous lessons?" remind them about the studied contents and validate the use of the parachute; if they haven't studied this is yet, here is the moment for the teacher to explain fluid and combustion.

Teacher: Teacher: "Who's going to operate the parachute? Roll the dice. It's an easy task, you need to take 10 (dice + skill). If one does not succeed, the other students try".

Teacher (turbulent music entering on Earth): "You fall into the sea, and open the spacecraft to leave, but it jams (soundtrack of sea). It starts to get water inside the spacecraft and you cannot get out, the space is very small (soundtrack inside the water)". The moment they cannot stand it anymore, the rescue arrives and saves them.

Teacher (victory soundtrack): "Finally, the warriors return to Earth! Lots of spotlights and journalists in their directions ... but with so much tiredness you do not even realize it, you all just want to go home and rest (here the suggestion is to write as a final a particular activity that your students like a lot to do together).

### 3 FINAL CONSIDERATIONS

Sometimes, teachers have some difficulties to make their students talk and express their ideas. With this practice, we could observe that even the shyest students had participated of the game, they could expose their arguments and ideas, and could work collaboratively. This type of methodology make students discuss between them, evaluate their errors and hits, and the teacher can easily perceive what the students had learned and what they hadn't.

There are many ways to use this activity. The teacher can use it to teach new contents, as it was performed during the game, in the part where the participants arrived on Mars; it can be used as a review of all the programme of that module, with the teacher using every theme treated over the semester; or even it can be used as an evaluation. Mostly, because the students are so engaged with the activity, they don't realize that they are being evaluated, which make this a good instrument for this purpose: we will truly know what they had learned.

We chose to cite here one of the most significative reaction of one student that occurred when the spacecraft lost its path. One of the students told the other that they could go to Jupiter (by Newton's First Law) and to use the planet's gravity to go back do Mars, saving some fuel. We can perceive that the student not only learned the Newton's laws during the previous classes, but he could apply this knowledge to a new situation. Of course, the teacher can manipulate the adventure so that the students answer him with what he wants to hear, but in some situations, the master can be surprised with the strategies and creativity that were stimulated by the game.

Using the perspective of the constructivism, we can evaluate this kind of response as an indicator of high level of effective learning, and in future works, we intend to analyse carefully the student's response from this perspective.

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