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Design Thinking for Space Exploration

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Abstract

The next generation of humans in space is now entering schools. Space exploration and data management have now to be integrated in the training of the future Space and Earth explorers.

This challenge will require different types of careers, talents and skills. The profile of the 21st century student needs to encompass the learning pillars required for any worker in the future labor world, the 4 Cs: Communication, Critical Thinking, Collaboration and Creativity.

These are the key requirements of any modern standards for school education. To achieve this, a large global effort needs to be put in place. A new education strategy is necessary, where students and communities work together for the construction of a modern and relevant school system, a system that goes beyond the school walls into the community and vice-versa.

1. Introduction

At that same time the topic of space exploration is invading headlines, with thrilling information about new planets being discovered, new missions being designed, new careers being foreseen and the possibility of humans living elsewhere, outside the safety of our planet and far beyond the orbit of the Moon, students are entering their schools, following their daily routine.

Most of the school systems in the world are trying to find optimum solutions to make their students thrive in the world of work. However, schools are built in such a way that very commonly we find teachers and students struggling to perform well in a single event, entering University.

Space Exploration will require and has always been about reaching the limit of our technology and bringing us beyond. This can't be taught in schools or University. Individuals taking up these challenges must have creativity, critical thinking, perseverance among other important skills. In this paper we refer to a few projects that are trying to support the change of the education paradigm in schools. Moving from a content delivery and structured format to a individually tailored solution. We present here a few initiatives that are being presented to educators and how we foresee their impact for the work force of the future.

2. Interdisciplinarity with the Big Ideas of Science

Space exploration is a perfect topic to bring innovation to classrooms. It has a strong interdisciplinary character, requires several important skills and sparkles the imagination of the young minds. Successful educational systems, like for instance in Finland, with their phenomenology based learning project, are trying new models where teachers from all subject domains have to collaborate to deliver the same topics, seen from the perspective of their own field. In the framework of the project Stories of Tomorrow, funded by the European Commission in the framework of the H2020 research and innovation program, this strategy is being adopted.

Students, from 10 to 12 years old, have to create a digital book about a mission to Mars. The mission encompasses several different phases ranging from the full preparation of the mission, the trip and finally a sustainable settlement on the surface of the red planet.

In order to prepare their teachers, we have introduced them to the concept of the Big Ideas of Science, a collection of ideas that tries to aggregate the

milestones of the scientific knowledge in all science domains. This main pillars can be further developed within each discipline and from different angles. For instance: human anatomy in space can be explored under the big idea "Cell" and its implications for those travelling in space can be explored in the framework of natural sciences, physical education, arts, etc. Teachers can collaborate for the preparation of each specific topic and the aggregate of ideas be used to improve the preparation of the student's digital stories. Another important part of this mission was the autonomy of the students and the importance of their own research for the specific challenge they had in hands. For this another component was introduced to their educators: Inquiry Based Learning (IBL)

3. Inquiry Based Learning

IBL is a learning methodology where students are invited to follow the steps of a scientific discovery. For the construction of their stories students had to solve a series of issues related to a variety of situations. For instance, how can we travel to Mars, how long would it take and how much material would be necessary? How can we build a community on Mars? What type of expertise would be necessary?

The solutions to these problems could be delivered to the students as a list of things to do and thing not to do. But this was not the approach of the project, the main idea was to invite students to find the problems and their respective solutions by gently guiding them towards the desired end. Using this model is not always comfortable for the educators who are accustomed to a more traditional way of delivering knowledge to their students. In the framework of the project PLATON, a project co-funded by the European Commission in the framework of the Erasmus plus program, a series of tips and trick on how to properly implement inquiry were created. A package was produced where IBL was divided in nine main components. The Inquiry under the Microscope toolkit. Equipped with this tools teachers are more likely to engage their students in projects such as Stories of Tomorrow.

4. Design thinking for Space Exploration

Another important aspect needs to be taken into account. There is no recipe for a success story when we are dealing with schools, teachers and students. Each case requires a different solution. In some of the schools involved in the project the ICT infrastructure was good enough to enable a smoot creation of the different stories. Some of the schools had good computers but their internet connection was challenging. In some cases, students had only one teacher and in other cases more than nine educators were in charge of the tutoring of the participants.

In some of the schools, teachers were not convinced that exploring Mars was something with any relevance for the future of their students. In other we had to convince the parents that these experience was introducing their children to content and competencies that were relevant to their future. To accommodate all these diverse realities, we had to use a bit of Design Thinking, a methodology that requires an individualized coordination. First it is necessary to "Feel" the environment where all the experience is taking place, next we had to "imagine" a possible solution to each challenge, next "Do" phase took over where we had to implement the designed proposal and finally we are in the process of "sharing" the outcome.

The four phases of Design Thinking are crucial in order to ensure an optimal uptake of the project. This process is being developed in the framework of the project Open Schools for Open Societies, in the framework of the H2020 research and innovation program.

5. Conclusion

The use of these different models and strategies are key in order to inspire and encourage students to reflect on the challenges of space exploration. They are also important to engage educators and parents in fruitful discussions about the importance of Space Exploration in our daily lives. Storytelling can act as a catalyst and trigger for interdisciplinarity and the promotion of STEAM (Science, Technology, Engineering, Arts and Mathematics) disciplines.

References

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Design Space Exploration (DSE) refers to systematic analysis and pruning of unwanted design points based on parameters of interest. While the term DSE can apply to any kind of system, we refer to electronic and embedded system design in this article. Given the complex specification of electronic systems and the plethora of design choices ranging from the choice of components, number of components, operating modes of each of the components, connections between the components, choice of algorithm, etc Space exploration isnâ€™t exactly cheap especially when its intangible benefits considered! How do you put a dollar value on scientific knowledge or inspiration?Â Let's face it, space exploration isn't exactly cheap! It takes the equivalent of millions of dollars to send even a single robotic mission to space, and billions of dollars to send astronauts to orbit. If you're looking to send explorers to even the nearest celestial bodies, chances are the costs will run into the hundreds of billions.Â These cost overruns have been largely due to apparent design flaws and technical failures which resulted in the loss of multiple aircraft during testing. But according to some critics, the program has endured because it has effectively become "too big to kill".