

Creative Approach to Engage on Scientific Topics – Cultural Collisions Online

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We present the results of a first cycle of the unique Cultural Collisions programme run entirely online over one school year 2020/2021 in the South East Europe region. Cultural Collisions is a novel cross-disciplinary science engagement, networking and education programme designed to stimulate the interest of high school students in science by introducing the methods and concepts of art and creativity into their standard science studies. It is based on a unique collaboration of international, national and local partners (scientists, artists and educators), using modern communication tools which in particular facilitate the participation of inner city and rural communities. It provides access to, and is supported by, science centres and museums through workshops and exhibitions. Cultural Collisions Bosnia and Herzegovina brought together 11 working groups in 6 different Bosnian cities and was run entirely online. During a whole school year, a total of 130 students participated in workshops and 556 in complementary events, including virtual visits and public lectures. They were supported by a unique collaboration of their teachers, local artists, local and international scientists, and demonstrated strong interest and enthusiastic engagement. Their commitment and efforts have resulted in an enhancement of their skills, an improved understanding of big science questions, scientific methodology, and an enhanced ability to discover creative solutions to complex problems. Furthermore, the programme demonstrated that the creative approach to engage with scientific topics encourages an increase in the participation of girls. The program was organized by ORIGIN/CMS following the Cultural Collisions methodology of previous successful similar programs in Canada, Germany, Switzerland and Austria.

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1. Introduction

We are in the middle of the technological as well as social change of the 21st century and it is not only necessary to meet the challenges, but also to prepare the coming generation in the best possible way. Challenges such as climate change, digitalization, migration and other topics require sustainable cultural responses. This requires young, dynamic people who are not only willing to develop new solutions, but are also trained in critical and creative thinking. Creativity is essential for the scientific and the artistic communities. Besides specialization in their fields, both the scientific and the artistic communities can learn a lot from each other's different processes and approaches to problem solving. Many solutions are in preparation or already exist, however it takes creative minds to recognize opportunities and to create something new. The dialog between creative communities must be promoted and implemented, so that it is perceived as attractive and will be applied by the next generation.

*"Our world has become more complex, more multi-layered, more interwoven. While the scientific landscape is characterized by increasing fragmentation, producing more and more specialized knowledge, it is becoming more important to think and act in context because everything is related to everything else. Non-linear thinking, the ability to imagine, the ability to make unconventional connections, the willingness to question the familiar in order to develop new scenarios from it, are the foundations for building a creative society."*¹

'STEAM' stands for Science, Technology, Engineering, Arts, and Mathematics. It is an interdisciplinary education approach that facilitates the integration of multiple disciplines to find creative and innovative solutions. STEAM education, driven by evidence and inquiry based learning through international project-based collaboration and networking, allows students to learn these skills.

Cultural Collisions² is an interdisciplinary educational art and science engagement and networking format that enables students to gain authentic and personal access to the world of science and to approach complex issues with the assistance of artistic processes. This format has been developed and tested over the last 10 years. It started from the "Science&Art@School"³ program which was introduced in 2013 with Austrian schools in Graz and Vienna and has been the base of the 'Science and Art across Italy' "Science&Art@School"⁴ program organized by INFN as well as the EU H2020 project CREATIONS⁵. Both formats have been developed at CERN by the international collaboration CMS within the art@CMS⁶ program.

The aim is always to create a local learning and encounter HUB. In the context of a sustainable promotion of technical and scientific, and creative competences, this empowers and exposes pupils to the diverse subject areas of the participating universities while they are still at school and thus inspires them at an early stage in preparation for their later choice of field of study. The process that the students go through during the workshop allows them to acquire scientific competences as well as to discuss and express creative approaches in artistic dialogue. The decisive factor for success is direct contact with real scientists and artists who are perceived as role models and can give the pupils personal insights into their professional life and work.

¹ G.Bast (2017), Von der Kultur der Kreativitaet; <https://www.creativeaustria.at/2017/01/01/von-der-kultur-der-kreativitaet/>

² M.Hoch (2019), Cultural Collisions, a cross disciplinary science education format, 40th International Conference on High Energy Physics, POS (ICHEP2020)946

³ M. Hoch et al. (2014), art@CMS SCIENCE&ART@SCHOOL: Novel Education and Communication Channels for Particle Physics; 14th ICATPP Conference, Vol. 1, 728-736

⁴ <https://artandscience.infn.it/en/>

⁵ CREATIONS EU H2020 Project. URL: <http://creations-project.eu>

⁶ art@CMS an education program of the CMS experiment at the LHC. URL: <http://artcms.web.cern.ch/artcms/>

2. Cultural Collisions Bosnia and Herzegovina format during Covid19 pandemic

The standard Cultural Collisions program schedule consists out of three phases: Phase1: An introduction and inspiration event; which is usually a cross disciplinary science and art exhibition, where lectures on scientific and artistic topics are presented and science and art workshop are organized. Phase2: Development of the topics at the schools: Work of the students with art or music teachers in dialogue with the science teachers at the schools over several months. Phase3: Final presentation of the pupils' works: exhibition of the works of art created by the pupils in a museum with reference to the scientific topics which inspired them, possibly again with a supporting programme.

The aim is to awaken a creative interest in science among young people. It also facilitates career planning in the field of technical professions or applied research in order to increase the human potential for the RTI sector (Research Technology Innovation). The exhibition and the supporting programme create a meeting space between professionals from science and the arts and students.

"We are at the beginning of a 4th industrial revolution and educators are confronted with preparing a generation of students for many jobs that do not yet exist. It makes sense to equip our children with the skills to think outside the box with creative solutions. STEAM education can prepare them for this." ⁷

Since March 2019 the world has been significantly disturbed by the global Covid19 pandemic. To cope with hygiene restrictions and social distancing, a big fraction of educational engagement and networking has been transferred to online technology.

When it became clear in summer 2019 that the Cultural Collisions kick off exhibition could not be organized as an event with in person presence, a two-day online symposium was proposed with regional speakers for various scientific topics, as well as artists and personalities from cultural institutions. The. "Cultural Collisions Bosnia and Herzegovina – Past Present and Future of the Universe symposium" ⁸ was organized on November 6th and 7th 2020 fully online. The more than 150 school students participating came from 6 different cities. During the second day of the opening symposium the students started the discussion about topics and formed local working teams. The result was the formation of 11 working teams each consisting of students, teachers, local scientists and artists in Banja Luka, Gradačac, Mostar, Sarajevo, Tuzla and Zenica.

To support the 2nd phase of the Cultural Collisions program a series of 'Ideas and Rehearsal Sessions' were scheduled on average each 2nd month. The aim and purpose of these 'Rehearsal Sessions' was to keep the students hooked to the initial dialogue and help them to use the new network to foster their scientific research and art practice. Moreover each team was invited to request additional special online dialogue sessions with our international as well as regional teams of scientists.

The detailed project proposals of all 11 teams were presented at the "1st Ideas and Rehearsal Session" ⁹ on December 12th. Additional Rehearsal Session were organized on March 6th ("2nd Session" ¹⁰) and May 26th ("3rd Session" ¹¹). As an additional inspiration for the students but also for a wider public in Bosnia and Herzegovina, a special dialogue session was organized in combination with a live broadcast from the CMS experiment at CERN, a 'Virtual Visit' ¹² on March 25th, 2021. During this event there were 556 live connections participating. Since several connections have been school classes, the total number of participants was estimated to be about 700 people.

⁷ B.Marr (2020). We need STEAM, not STEM Education; Forbes

⁸ <https://indico.cern.ch/event/970862/>

⁹ <https://indico.cern.ch/event/1015445/timetable/#20201212>

¹⁰ <https://indico.cern.ch/event/1018237/>

¹¹ <https://indico.cern.ch/event/1041786/>

¹² <https://indico.cern.ch/event/1018237/>



This addendum program of the CMS virtual visit at CERN event was designed to be a dialogue between various regional stake holders.

Introductory contributions were given by the organizing committee, the director of the Austrian Cultural Forum, Sarajevo, the Science and Youth minister of the Canton Sarajevo, the vice rector the University Banja Luka and an art gallery director of Mostar. The dialogue session was followed by an introduction to the science and technology of the CMS experiment at CERN with a live broadcast walking through the CMS

experimental cavern. Including the Q&A session the whole event lasted two hours.

Due to the ongoing Covid19 situation at the end of the school year the final presentation of the student art works was organized in the format of a ‘hybrid event’. The Cultural Collisions Bosnia and Herzegovina Hybrid Vernissage¹³, was a novel format where the participants and local audience from all 6 cities in Bosnia and Herzegovina came together in just two cities (Banja Luka and Sarajevo). Both cities as well as international guests and participants were connected via an online broadcast. The speciality of the event was that a large variety of high level people including representatives of local stake holders, opinion leaders and international guests were present. During the 90 minute dialogue session 3 ministers of different regions, 5 vice rectors or university faculty members, 2 city mayors, 2 members of an international organisation, 1 DAAD project leader and 1 member of the diplomatic corps gave contributions.

3. Feedback, Motivation, and Engagement of the students

As with all Cultural Collisions programs organized to date, the students became highly motivated and engaged into the project. The direct contact with local and international specialists involved in science and the arts stimulated the participants to feel their professional enthusiasm and motivation. Furthermore, students started to intensify their own research and engage even more in their art practice. Below are some direct quotes of students who participated in the Cultural Collisions 2020/2021.

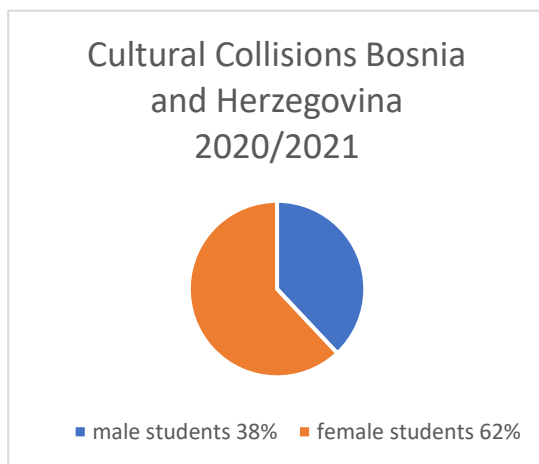
Ilma Spahić, 17years/ Zenica: Participating in the Cultural Collisions 2020/21 project was one of my greatest experiences. The first and foremost skill I got to build was teamwork, and I learned how much it takes to be an effective leader. We built something from scratch, which was not easy at all, but the organizers provided us their selfless support. This was a great learning experience – about myself, about other people, and about universe. The topic selection was great, as this was an unprecedented opportunity to learn more about such an interesting topic not covered this great

¹³ <https://indico.cern.ch/event/1047913/>

into detail in school. It was incredible to meet people from all across BiH who shared the same passion about the topic of undiscovered universe and see their artistic interpretation of it. Seeing so many different forms of art interpreting different aspects of the same topic was astounding, and that is where I found the true meaning of this project.

Valentina Knežević, 17years/ Banja Luka: This was an amazing opportunity and experience. It made me think about how science can be presented through art and acting. With our imagination we can make beautiful stories and show people around us how we see space and everything that has been discovered in the past, from the beginning of space creation to today's mindset and theories. As a team, we made connections with each other and together created something we're all really proud of.

Hannah Li Ligata, 16 years/ Sarajevo: I believe this project had a great aim. Connecting art with science is wonderful, and showcasing how these two areas of knowledge can be intertwined, instead of teaching us that they are mutually exclusive or that one is superior over the other is of great importance. Giving students the opportunity to work in groups alongside their teachers was very valuable, at least it was for me, and so was offering them the chance to present some vast and complicated areas of physics in their own way.



It is worth noting that, as in previous Cultural Collisions programs in other countries and continents, the participation of female students outnumbered male students. Further investigation is needed to determine whether creative approaches to scientific topics encourage female students to consider careers in science or technology. In addition, studies are ongoing to answer the question which age groups need to be addressed to significantly foster the curiosity and interest in science in general as well as trigger creativity as a model of cross disciplinary problem solving strategy.

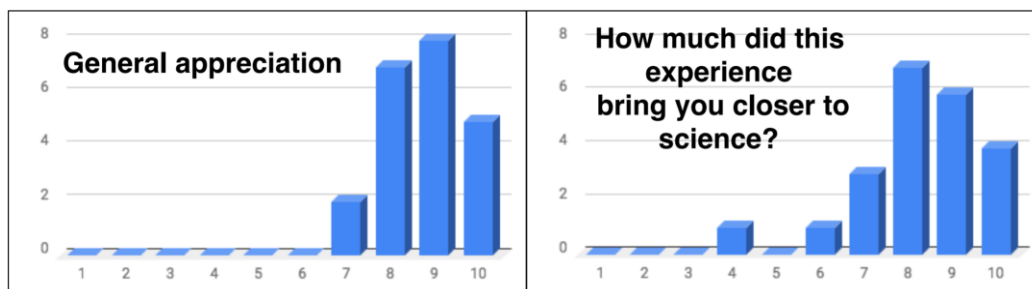


Figure: S.Paoletti and Paolucci, 2019" ¹⁴

4. Conclusions

The main aim of the Cultural Collisions cross disciplinary format, to introduce students to science methodology, stimulate curiosity, encourage critical thinking and foster creative processes was well demonstrated by this exercise. In particular, the final works presented during the Hybrid Vernissage ¹⁵ on June 18th showed that the students had been inspired, had become committed, and developed a much better understanding of the core subjects. Furthermore, the students had understood the important role of networking and teamwork. Networking within their own peer group, the local community and also through the opportunities developed using the international connections created during the project.

¹⁴ S.Paoletti, P.Paolucci, Art as a language to represent Science: a project for Lyceum, PoS(EPS-HEP2019) 456

¹⁵ <https://indico.cern.ch/event/1047913/>

The Cultural Collisions Bosnia and Herzegovina 2020/2021 format was very successful and will be organized again for the school year 2021/2022. In parallel it is planned to create similar programs in the neighbouring countries, Serbia and Croatia. In addition, at the DAAD – CONNECT2020¹⁶ workshop in Neum/ Bosnia and Herzegovina August 2021, the Cultural Collisions 2020/2021¹⁷ program was discussed and preparation has started to enlarge the network across neighbouring countries for a 2021/2022 version connecting people through the motto ‘Science and Art Connecting People’.

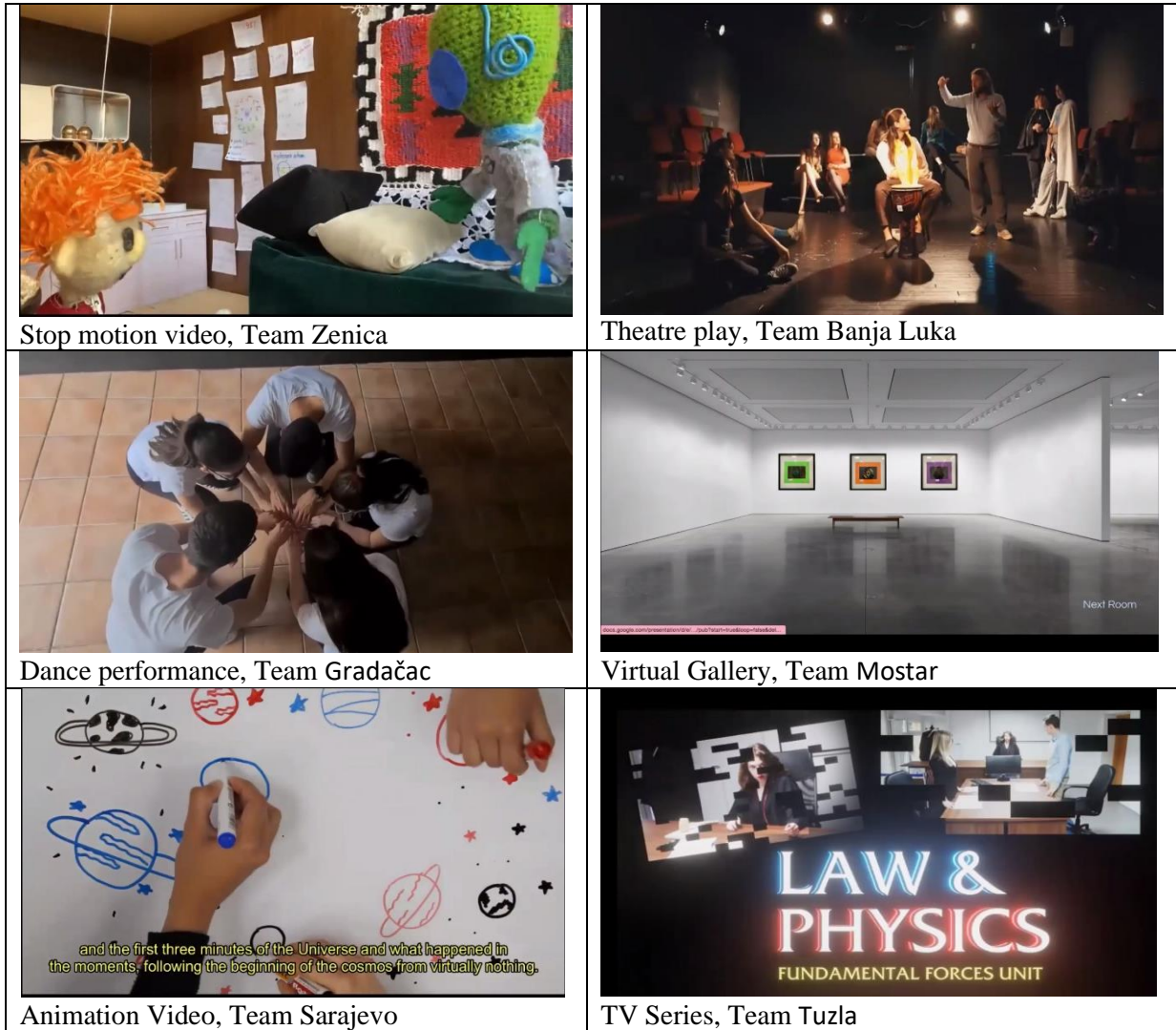


Figure ; Selected works presented during the Hybrid Vernissage June 2021;

POS (EPS-HEP2021) 890

¹⁶ <https://www.connect2020.online/p/connect21-project.html>

¹⁷ https://mhoch.web.cern.ch/Art@CMS/2021_CulturalCollisionsBosnia_summaryMHoch_CONNECT2021.pdf