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2nd Workshop on Astronomy Beyond the Common Senses for Accessibility and Inclusion (2WAI)(Virtual-Modality, November 17-18, 2021)
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INTERNATIONAL COLLABORATION FOR SCIENCE EDUCATION IN UNDERPRIVILEGED AREAS: THE CASE STUDY OF THE ALL-GIRLS "SCHOOL OF ASTRONOMY AND PHYSICS BY MIRWAT" IN PAKISTAN AND VIRTUAL VISITS TO THE VIRGO INTERFEROMETER

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ABSTRACT

As the world witnessed a swift change in every walk of life during the SARS-Cov2 pandemic, flexibility and adaption remained the key components for staying relevant in the field of science education. However, beyond the need for quick adaptation and acquisition of digital skills by both teachers and students, the digital transformation in education has opened up a window of opportunity making global and remote engagement possible for everyone. This paper presents the good practice of Virtual Visits to Virgo Gravitational Wave Detector co organized by EGO-Virgo, the FRONTIERS and REINFORCE EU funded projects and the "School of Astronomy and Physics by Mirwat" with the participation of high school girls from Islamabad and remote regions of Pakistan. This paper presents the prospect of international collaboration for STEM education, early exposure to research environment to build the deeper understanding of the functioning and working of large research infrastructure, building science identity by informal science experiences and to empower the high school students by engagement in content creation activity. The experience indicates a positive outcome and improvement in understanding of students as well as a step towards building a science identity among them.

RESUMEN

A medida que el mundo fue testigo de un cambio rápido en todos los ámbitos de la vida durante la pandemia del SARS-Cov2, la flexibilidad y la adaptación siguieron siendo los componentes clave para mantenerse relevantes en el campo de la educación científica. Sin embargo, más allá de la necesidad de una rápida adaptación y adquisición de habilidades digitales tanto por parte de docentes como de estudiantes, la transformación digital en la educación ha abierto una ventana de oportunidad que hace posible el compromiso global y remoto para todos. Este artículo presenta la buena práctica de las visitas virtuales al detector de ondas gravitacionales de Virgo coorganizadas por EGO-Virgo, los proyectos FRONTIERS y REINFORCE financiados por la UE y la "Escuela de Astronomía y Física de Mirwat" con la participación de niñas de secundaria de Islamabad y lugares remotos de Pakistán. Este documento presenta la perspectiva de la colaboración internacional para la educación STEM, la exposición temprana al entorno de investigación para desarrollar una comprensión más profunda del funcionamiento y funcionamiento de una gran infraestructura de investigación, la construcción de una identidad científica mediante experiencias científicas informales y el empoderamiento de los estudiantes de secundaria mediante la participación en actividades de creación de contenidos. La experiencia indica un resultado positivo y una mejora en la comprensión de los estudiantes, así como un paso hacia la construcción de una identidad científica entre ellos.

Key Words: international collaboration — STEM — science education

1. INTRODUCTION

The collaboration of the project "School of Astronomy and Physics by Mirwat" in Pakistan with international research facilities aims to promote educational opportunities to cultivate early research exposure/experiences for high school girls and underserved community through informal engagements. Another core focus is to develop a science and in particular physics identity among girls to help see themselves as science person.

Early research exposures and informal science encounters provide lifelong skills, assist learners in moving toward future goals/careers and lead to satisfaction with their chosen careers (Clemente & Belgrave 2019). This contrasts with the formal school-based curriculum which limits the deeper understanding and usually lacks authentic science exploration (Hazari et al. 2022). Covid-19 pandemic has adversely affected every walk of life globally but on

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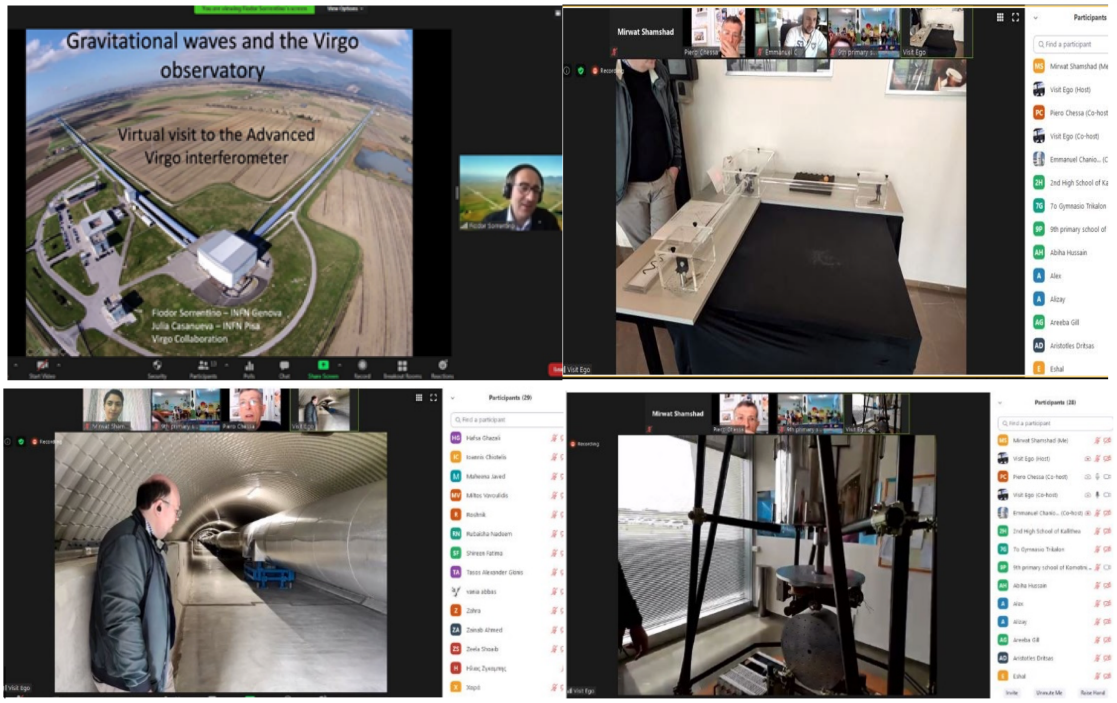

Fig. 1. Clockwise from top left. ESO scientist introduction to Virgo & GWs; Virgo Model inside the facility; ESO scientist gives tour to 4 km long tunnel; Pendulum Model and gravitational wave detector.

the counter side has opened entirely new innovative learning opportunities. It has brought the world digitally closer and more connected than ever before hence opened an era of "Socializing from a distance" (Fischer 2021). New digital paradigm in education has opened new learning platforms and avenues for collaborations. New intellectual, organizational, physical, and digital spaces are created to keep learning uninterrupted in the crises posed by pandemic (Fischer 2021).

Virtual visits are mode of informal engagements to provide collaborative remote tours to research infrastructures for global audience. They play vital role in enhancing real field work and offer learning opportunities beyond classroom settings even for the disadvantaged students by breaching and removing the financial barriers (Stainfield et al. 2000). Informal academics and scientists think that students' STEM identity cannot be completely established until they have opportunities to see and participate in authentic research with scientists, a practice known as apprenticeship (Hay & Barab 2001; Sadler et al. 2010).

This papers discuses in the light of international collaboration, the impact of the VIRGO virtual visit and engagement through content creation activity.

2. METHOD

Virtual Visits: during pandemic a virtual visit to the Virgo Gravitational Wave Detector was organized in the framework of the "Frontiers (www.frontiers-project.eu) And Reinforce (www.reinforceeu.eu) EU Projects". Girls from Islamabad and remote mountainous region "Gilgit-Baltistan" of Pakistan participated in the activity. This tour has offered participants the opportunity to learn about Gravitational Waves, how they can be detected at Large Research Infrastructures like VIRGO while interacting directly with the researchers and scientists at the facility (Fig. 1).

Technology used: the Zoom video conferencing tool was used and despite a low-quality internet connection at remote locations all activities were conducted in a satisfactory manner.

Pre-questionnaire: a questionnaire was posed to students for gauging their familiarization and understanding of gravitational waves and big infrastructure like VIRGO facility. The Participants undertook pre-questionnaire before the virtual visit.

Introduction to GWs: an introductory session on GWS was arranged by the teacher organizing the event locally. The aim was to create relevant understanding of gravitational waves for the participants.

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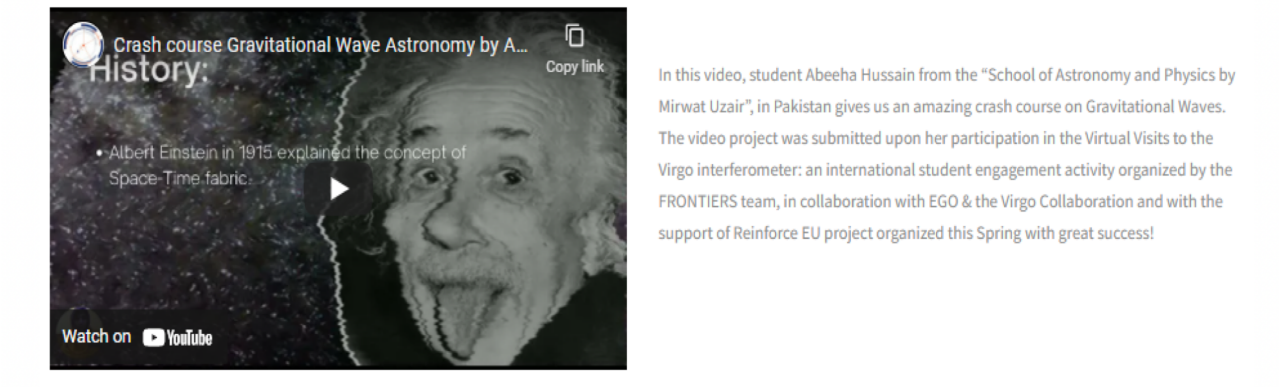

Fig. 2. Example of a video project developed at the "School of Astronomy and Physics by Mirwat Uzair".

Its purpose was to acquaint them with some background knowledge and the related scientific vocabulary.

Virtual visit: the students undertook a virtual visit of VIRGO facility. They were provided a virtual guided tour of the facility with ESO science collaborator/scientist. As follow up to the visit, student queries were also entertained by ESO staff.

Post questionnaire: for measuring learning outcome for the students, a post questioner was processed among the participating students. Students under took post questionnaire after the virtual visit. Pre and post questionnaire results were compared to analyze the impact of the visit on students understanding of GW's.

Post activity - Video making: this post activity aims to empower participating students and enhance deeper understanding by engaging them in content creation activity. participants created their own a minute long high-quality outreach videos explaining gravitational waves and how they are produced and what Virgo is.

3. QUALITATIVE ANALYSIS - IMPACT OF THE VISIT

Questionnaires were used to collect data/information on participants' overall interest in learning science and its relevance to their lives and prospective careers in science. The objective and utilisation of large research infrastructures for society and for them: Vocabulary and knowledge to assess students' understanding of Gravitational Wave principles and technical jargon, as well as their ability to confidently describe VIRGO to a friend before and after the visit. The analysis of the participant response indicates, in general, a significant increase in understanding students' familiarity with principles and technical terms regarding Gravitational Waves. Similarly, student feel more confident while explaining VIRGO to a friend after the visit. However, preliminary data is being collected and will be published in full in future research.

Students follow up project: as a follow up, students created video content about gravitational waves and Virgo facility. It was later sorted and shared on the Frontier You tube channel. The students also shared their views on their learning outcomes that are gained Eventually the video of one of the participant from remote region of Pakistan, "Gilgit Baltistan" was selected and featured on Frontiers Youtube challenge as shown in Fig. 2.

Students Reflection on Virtual visit: Reflections of students sharing their feedback for the virtual tour to Virgo and its impact on their learning and choice of future careers.

"The VIRGO remote visit was a very memorable and informative experience for me. I got a deeper insight and understanding about how physics concepts are being used in real life to detect things that exist way beyond our imagination. I got to see a remote facility miles away from my country and felt as if I was right there. The entire staff of scientists and researchers were very cooperative. I am really grateful that they arranged such a wonderful trip for young students who try to grasp all the knowledge they can get." (17 year old student from Islamabad, Pakistan.) *"The session was so interesting, informative and enjoyable. It helped me to increase my knowledge in physics. I appreciate and thanks to everyone for this opportunity. I wish we could stay connected by getting more knowledge."* (15 years old female student from Gilgit Baltistan, Pakistan).

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4. CONCLUSIONS

This collaboration with FRONTIERS and REINFORCE teams, was instrumental in bringing Nobel prize physics to the school and inspiring young generation. The analysis of students experience shows a positive improvement in their learning about gravitational waves and enhanced interest in doing science. The prospects for future collaborations may be focused on students to get a experiential learning of working on VIRGO data that could be really immersive and experiential.

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