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# Reframing Pedagogy: Teaching Astronomy through STEAM Innovation

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**Abstract.** This contribution explores the reframing of promoting Astronomy as popular science, inspired by the COVID-19 pandemic. Through STEAM Innovation, integrating science and arts, such as Astro-Music and Space Art, would be a case in point of forced association. It redefines our methodology of Astronomy education and encourages the engagement of teachers from other disciplines. Supporting with user-centered design thinking, this pedagogy contributes effectively to the interactive teaching for solving real-life problems related to Astronomy.

**Keywords.** STEAM Education, Astro-Music, Innovation, Astropreneur

## 1. Introduction

The pandemic situation of COVID-19 had changed our daily lives, especially the forms of promoting astronomy and popular science. Many new events had been launched without borders, such as Astro At Home, virtual stargazing, conference live streaming, and online night sky observation. It then raised a follow-up question about the future of Astronomy Education, changing from sidewalk astronomy to interactive digitalization. For better implementation, it is crucial to consider the interdisciplinary approaches to effective teaching, based on the methodologies on Astronomy Education. Face-to-face lectures may possibly be replaced by convenient online platforms.

STEM Education has already been launched for several years in Hong Kong, which is mainly dominated by industries related to robotics, mechanical engineering, computer programming, and AI technology. It may raise a question on how could we can learn Astronomy or even Natural Science through STEM Education? How could we think out of the existing box, which are practically observational Astronomy and theoretically Astrophysics and Cosmology?

## 2. Overview

Based on observation and engagement in Astronomy Education and outreach programs in the past few years, I would like to propose a new idea called "STEM+A@Astronomy oriented". It was inspired by famous astronomer Kepler's famous piece of "The Harmony of the World" (Harmonices Mundi) (Gingras 2003). As he discovered the consonance between the planetary motions and music, he became the pioneer of Astro-Music and proposed his Third Law of Planetary Motion (Russell 1964).

One of the Astro-music pieces composed was "Valentine's Rosette" (Fig. 1) which was related to the digital composition of interactive music generated by the images of Rosette Nebula, as a well-known dark sky object. This music was innovatively composed, based on its stellar structures and nebulous features, such as NGC 2237, NGC 2238, NGC 2239, NGC 2244 and NGC 2246, celebrating Valentines Day in 2020. It would be my honour to

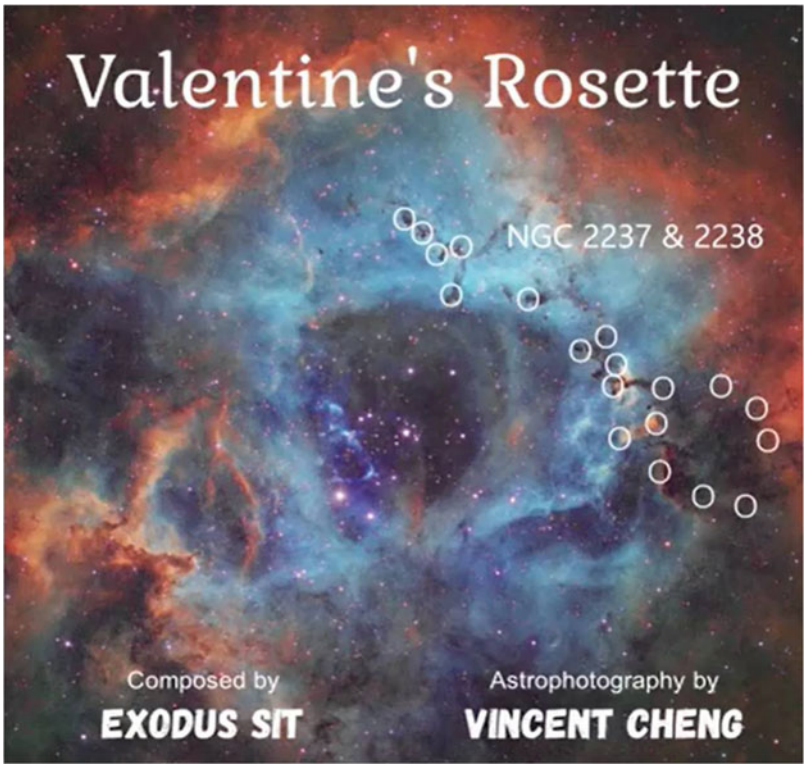


**Figure 1.** "Valentine's Rosette" as an example of Astro-Music composition.

cooperate with local astrophotographer with photos demonstrated in both Hubble Palette and Hydrogen-Alpha Image-processing. As the Prelude of "The Harmony of Mysterious Exoplanets" (Nebula), "Valentine's Rosette" had been showcased in TEDx seminars, Shaw-IAU workshop and IDA conference. It would be official performed in Hong Kong Space Museum in 2021, affected by the postponement of public lectures.

As for the instrumentation selected, it would be performed by Steel Tongue Drum. It is an unique musical instrument which can simulate the feeling and sound of Astro-Music. Inspired by the universal music (musica universalis) (Birat 2017), conceptual music could demonstrate the abstract connections and internal consonance of "Music of Sphere" model vocally. It would be a new interactive media to motivate people who are interested in Astronomy or Music.

## 3. Implications

Astro-Music is a flawless illustration of "STEM+A@Astronomy oriented". It is different from traditional STEAM Education, as we focus on Astronomy as the core subject on having connections with other potential fields of studies, no matter they are science-related or not. During the integration of Astronomy with other disciplines, we could generate more and more possibilities or even new Astronomy-related subjects in the future. Technically, it would be a progress of Forced Association (Mcfadzean 1999). By integrating Science and Arts, it could then form a new subject, such as Astro-Music.

For reframing astronomical pedagogy, we could try to think like an "Astropreneur" (Astronomer + Entrepreneur), who would be familiarized with future abilities, holistic design thinking, confident mindsets, and creative advocacy for preparing unexpected

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incidents in the future. To have an effective communication of popular science, it is suggested to consider learner-centered approaches (Michael 2005), focusing on what people wish to learn, rather than what we think they might be interested in. Music could be an incentive to motivate the general public to explore Astronomy.

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