The Age of Enlightenment in the New Method of STEAM Approach: Apple-Tree of Johann Sievers (Germany, 1762–1795)

The goal of article is to explain and demonstrate the new method of STEAM (Science, Technology, Engineering, the Arts, and Mathematics) approach – SMS (Stories based on Music about Scientists). SMS as the artistic method is comparable to the Greek symposium's traditions and fits well under STEAM approach, with its integrated nature of Science and Arts. It is designed to integrate science, education and the arts into a synthesis of creativity and innovation. The theoretical background of STEAM SMS is research about scientists and their innovations demonstrated in the creative form of musical ballads. Its methodology is based on experimental design of the author's music and the poetic discourse linked to the research about scientists' heritage. Contextual understanding is delivered through the means of poem and creative visual Art. The examples of SMS provided refer to German scientists of the Enlightenment era in the fields of biology. The main example is the ballad about Johann Sievers's apple-tree which was proved as a progenitor of apple trees on the Earth, a cultural heritage of the natural environment. The goal of this learning method is to revive the interest of the broad public towards innovations of the past and boost innovations in STEM.

Keywords: *STEAM, stories based on music about scientists, Johann August Carl Sievers (1762-1795), Samuel Gottlieb Gmelin (1744–1774), science and arts*

Introduction

The symposium was an instrumental part of ancient Greek culture from the 7th century BCE, where guests demonstrated poetic and intellectual skills, discussed different topics of philosophy, politics with the performance of singing and recitation of poetry.

The new method of STEAM (Science, Technology, Engineering, Arts and Math) approach abbreviated as SMS (Stories based on Music about Scientists) is comparable to Greek symposiums' tradition – with its components of singing performance, music, and poem. The "A" roots of STEAM education also bring us back to the past time, to the ideas of Da Vinci who wrote that the principles for the development of a complete mind are grounded in the science of art and the art of science.

The goal of this article is to introduce, explain and demonstrate this novel SMS method of education with its pioneering nature that promotes a European cultural heritage of innovations. It was designed in 2012-2013 years to integrate science, education and the arts into a synthesis of creativity and innovation. It was invented independently from the STEAM movement in America, where STEAM was launched "as an opportunity for America to sustain its role as innovator of the world" (Maeda, 2013, p. 2).

SMS method by its essence includes creative elements (Music, Poem and Virtual Art), incorporating aesthetics, creativity, and a research discourse about scientists´ discoveries with the idea of innovations. It is expected that SMS with its potential diversity would be very effective in boosting European innovations by attracting and accelerating the interests of students, professionals, stakeholders and a broad public towards high quality scientific knowledge with Science and Art together.

The SMS method was developed during 2012 - 2013 and demonstrated for the first time at the annual International Music Festival of Romances at the Russian Center of Science and Culture in Ljubljana, Slovenia in 2013. At the beginning, it was used as an experimental method in the form of individual Enlightenment project about the great people. It was also introduced without any reference to STEAM, because its concept of was not known at that time. The first emerged initiative was much broader, named as "Songs about Great People". Besides ideas about scientists and their innovations, this initiative also included great opera singers (like Feodor Chaliapin), Roman saints (like Saint Valentine, a 3rd-century Roman saint), and Generals (such as Pyotr Bagration, the general-prince of Georgian origin, during the Napoleonic Wars). Later, Songs about Scientists (SS) was targeted as the separate group. The initial idea was to revive the interest towards innovations of the scientists of the past through the key elements: Research of innovation (in its story of the past time and history), Music and Poetry as well as the digital images of innovations/or the author of innovation. The same idea remains up to the present time with more emphasis to the Science and Art (S&A) or STEAM approach. The method of SMS can be well placed under the STEAM, because music, poetry and the added elements of visual arts fall under the purview of "Performing Arts".

The method of SMS demonstrated in this article refers to the interesting research about the special type of an apple tree, which was first discovered in the mountains of the modern Kazakhstan by the German scientist and botanist Johann August Carl Sievers (1762–1795). Later (20^{th} century) it was proved that this tree is a progenitor of all apples. If continue this logic, then Adam and Eve were eating this prohibited fruit (and if this fruit indeed was an apple), and apples actually come from Central Asia (Kazakhstan), then Adam and Eve lived there…? The Arabian Nights features a magic apple from Samarkand capable of curing all human diseases, and DNA analysis indicates that apples originated in the mountains of Kazakhstan, where the wild Malus sieversii (Rupp, 2014). The story about the progenitor for all apples tree is presented in the form of a musical ballad (song) "Apples of Sievers". Johann Sievers in his letters from Siberia was making references on botanical works of Samuel Gottlieb Gmelin (1744 –1774), another German scientist. Sievers noticed large irises on his way described in the book of Gmelin "The flora of Siberia, or the History of the Siberian Plants", and both were covering the same fields. Gmelin was botanist, physician, and also explorer of marine biology – in the fields of marine algae (Istileulova, 2021). The SMS with its link to SMS on him is also provided for the matter of comparison.

Both of them lived in the same era of Enlightenment– the great "Age of Reason". The age of Enlightenment has been defined as the time of rigorous

scientific, political and philosophical discourse that characterized European society: from the late 17th century to the ending of the Napoleonic Wars.

Literature Review

Age of Enlightenment

The Enlightenment era derived unique inspiration from the Baconian confidence in "the happy match between the mind of man and the nature of things" (Rashkover, 2021). First, philosophers and scientists of the Enlightenment circulated their ideas through meetings at scientific academies with emphasis on learning, art and music (similar to Greek symposiums). If we want to find in classical philosophy a link between poetry, music and the fine arts, it is provided by the concept of imitation: Plato and Aristotle considered poetry, music, the dance, painting and sculpture as different forms of imitation (Kristeller, 1951, p. 504).

Second, the influence of science appeared in poetry and literature, and poetry became infused with scientific metaphor. Third, the age of Enlightenment boosted a lot of innovations with a new conception of instruments - musical, artistic, or scientific - as vehicles of discovery. It is considered that the Age of Enlightenment was an intellectual and philosophical movement that dominated Europe in the 17th-18th centuries in shaping a new understanding of man and individual. Fourth, it is also important that the Enlightenment has its roots in a European intellectual and scholarly movement known as Renaissance humanism: it was also preceded by the Scientific Revolution with the works and scientific instruments of Francis Bacon (17th century), who was also identified as the "Renewer of Arts" (Wolford, 2017). In the definition of the Fine Arts (music, poetry, painting, sculpture and the dance), Batteux tries to show that the "imitation of beautiful nature" is the principle common to all the arts, and he concludes with a discussion of the theatre as a combination of all the other arts (Kristeller, 1951, p. 21).

While the word "Enlightenment" did not yet exist, writers in English employed similar luminous metaphors to describe their epoch. Those who claimed to be living in an age of Enlightenment during the eighteenth century usually included reason, civility, tolerance for religion, commerce and freedom among its defining achievements (Domínguez, 2017). The German philosopher Immanuel Kant (1724-1804) in his essay "What Is Enlightenment?" (1784), answered: "Enlightenment is man's emergence from his self-imposed immaturity" (the inability to use one understanding without guidance from another).

Enlightenment thinkers were sensitive only to the influence of climate, geography and "custom" criteria of man existing within society, and man was capable of transforming and mastering the environment (Schettini & Murray-Miller, 2021). The logic was that the environment could be changed, entailing that humanity itself could also be altered and improved, allowing to realize its fullest potentialities and become virtuous (Schettini & Murray-Miller, 2021, p. 9). The various representatives of the Age of Enlightenment became the source of

inspiration for the author of interdisciplinary SMS method which can is organically embedded under the STEAM approach. In addition, SMS promotes both innovations and their cultural heritage.

SMS method is well-incorporated to STEAM approach under the Arts, where the central elements are music, poem and the visual arts/digital pictures). SMS method is mentioned in the original research dedicated to the German scientist and biologist Samuel Gmelin (Istileulova, 2021). Earlier, SMS had been promoted under the Science and Art's heritage about innovations of great scientists.

Storytelling from the Age of Enlightenment: Apple-tree of Sievers

"Apple-tree of Sievers" is one of the examples of musical ballads or stories based on Music about Scientists (SMS). Story is based on the book of Johann Sievers "Letter from Siberia".

Letters from Siberia by the young German botanist and pharmacist Johann Sievers (1762-1795) were translated in English and Russian languages by the International Fund for Preservation of Malus Sieversii, and published in 2018. Sievers described his detailed traveling from Irkutsk and its lake Baikal (from the Mongolian word "the hot fire") up to Ust-Kamenogorsk and other places, going through Alakol and Balkhash lakes. Besides detailed description of the plants, geology, hydrography, there is an interesting description of ethnographic and cultural traditions provided throughout of all his eighteen letters.

When Sievers was approaching mountain range of Tarbagatay (after the river Urzhar), he wrote: "When I arrived at the foot of mountains, the goddess Flora made me happy with the forest of the most beautiful dwarf apple trees which grow here wild on the both slopes. I forgot the tiredness, the heat, the rock fall and everything else and drove into the apple orchard, as the wood spirit, and enjoyed these apples…" (Nussenov, 2018, p. 56). The description of apples refers to "good tartaric taste, due to the wild conditions, they were crushed to the size of the chicken egg and had yellow and red cheeks... I wish to name this Pyrus as a new specie…"

Thus, his discovery – the wild Sievers apple tree (Malus sieversii) was named after Sievers by Karl Ledebour (1850). Russian scientist Nikolai Vavilov first identified the Malus sieversii as the progenitor of the domestic apple, *Malus domestica*, in 1929 (Hutton, 2018). "All around the city one could see a vast expanse of wild apples covering the foothills," wrote Vavilov of his visit to Almaty, then Kazakhstan's capital. "One could see with his own eyes that this beautiful site was the origin of the cultivated apple." Vavilov observations that all domestic apples may originate from Almaty (Alma-Ata – means "father of apples" has since been confirmed by modern genetics. Later on, the modern genetic studies also proved that this apple tree is the progenitor for all apples cultivators on the Earth, and their seeds were carried out for hundred years by caravans walking around the great Silk Road (Beijin – Lisbon) to Europe (Drakhavtsev, 2018).

Methodology: SMS vs. STEAM

SMS Method

The methodology of SMS is based on the experimental design of author's Poetry, Music and Visual Arts incorporating the elements of aesthetics, creativity, and poetic discourse about scientists' heritage with a research discourse about scientific discoveries (in this article - in the cases that belong to the Age of Enlightenment, 17^{th}-18^{th} century). Initial idea is to restore the great interest of a broad public towards the innovations of past (from the 17^{th} to 20^{th} centuries) through interdisciplinary approaches in STEM (Science, Technology, Engineering and Math) involving the creative arts, thus, becoming STEAM. STEAM approach (Science, Technology, Engineering, Arts and Math). Methodology embraces the materials dedicated to the heritage of selected scientists in the fields of STEM through the Case-Based-Research (CBR) method interpreted in the experimental design of Arts (STEAM approach).

The state of the art is presented here through poem and music, - a song or ballad. SMS method's key elements include:

(1) The original Poem (based on research – which is the independent important key step).
(2) Music (as universal language) and its main element.
(3) Visual Art (in its different forms of digital art: painting, drawing, images or video) about the interesting scientist from STEM disciplines of the past.

The formula of SMS can be broader:
SMS = Interdisciplinary Research-Story + Poem + Music (recordings/live performance) + Visual Arts (digital) + Performance.

On the other hand, besides key elements, the algorithm of SMS method requires certain steps (each one – with its own creativity and "creation"):

1. Research about Scientist that inspires the author about scientist or his/her innovation (innovations)/fields of STEM (usually, interdisciplinary).
2. Poem – written about scientist and his innovations (or a ready poem).
3. Translation of this poem in English (in a free form) (optional).
4. Explanation of some "specifics" of poem´s text based on research.
5. Music which is presented and performed together with original text as a musical ballad (or song).
6. Performance (singing and playing instrument (at least, one).
7. Recording in a digital format – in a digital music or digital audio synonymous with MP3 music or wav.
8. The digital image (related pictures, video, images or illustrations) about the context of main ideas.
9. "The final product" is presented (with all elements) and placed in any channels (YouTube channel, as the most common one).

Thus, SMS - Story based on Music about Scientists - the new original and innovative method which is introduced here with the purposes to attract the broad public interest to scientists, STEM or innovations through the state of arts´ engagement. The Arts in STEAM is a storytelling, the social and cultural activity of sharing stories or narratives, which are shared as a means of entertainment, education, cultural preservation or instilling moral values.

Researchers can use the poems originally written by scientists themselves or by other authors who wrote about scientists. For instance, the poem "The world's a bubble" was written by Francis Bacon (1561–1626), an English philosopher, lawyer and statesman who served as Attorney General and as Lord Chancellor of England: https://www.youtube.com/watch?v=c8v5-1S9S8k The more recent example includes the poem of Alfred Nobel, a Swedish chemist, engineer, businessman, and philanthropist, and inventor, who issued 355 patents internationally, and a story about this poem (when Nobel was only 18 years old) was placed in the website of https://bit.ly/3DkYNNd.

It is considered that SMS method with its 3 minutes stories will stimulate the interest of public towards innovations of the scientists and different areas of STEM from the very young public up to the mature scientists.

STEAM Approach

The arts integration is just one facet of STEAM paradigm, which can expand its various elements further, reflecting a view of education with an emphasis on creative, authentic interdisciplinary, real-world learning, and problem- or project-centered thinking or project-based teaching and learning (Kim & Park, 2014; Henriksen, 2017). At the same time, there is a frequent opinion that "discourse around STEAM has often viewed it narrowly, as simple arts-integration into the sciences" (Henriksen, 2017). Indeed, any learning usually starts from the simple mimetic isomorphism or coping experience from available successful practices

The SMS is a social innovation which intends to promote technical STEM innovations through the fields of Science and Arts (S&A) using the transformation power of all elements. The method of SMS makes the strong emphasis on the more emotional and spiritual context of Music and Poetry, with their powerful synergy between music and lyrics with their aesthetic spirit which is incorporating the inspiring ideas of scientists.

Since 2013-2014, the additional element of the Visual art was added to improve the understanding of lyrics with the power of digital images (video, pictures, portraits of scientists and their ideas), in addition to a short story about scientist (in a poem and music). A meaning of visual art in the digital form (either in the form of pictures, video excerpts or documentary photos) is very important, because it is connected with the main idea of ballad. If the ballad or song is not understood by the public due to the nature of language used in poem (English, Russian or others), the visual art brings the additional understanding about the main idea of content and context. Visual art includes also some rules in SMS - each ballad's presentation should include a visual portrait of scientist, his years of

life.

The criteria the experimental studies of STEAM SMS need to meet is to reflect the main idea about scientist or his innovation presented in inspiring, innovative, harmonic and creative ways to inspire the interest of the broad public as a new method of learning or teaching. It was first introduced in 2013 with the song "Baron Valvazor", and songs based on SMS have received the international awards from International Music Festivals.

All known civilizations, past and present, were engaged in the arts in at least one way or another. Musical creativity provides the new angles with music and a discourse linked to poem - a poetic story about scientist. The mechanisms associated with creative practice are poem, music together (thus, forming song/ ballad), and images (illustrations), science experience, as well as their interplay with broader aspects of human cognition. This allows us to explore, in novel ways, the neural, psychological, and behavioral processes involved in creativity; to gain a deeper understanding of the social and individual dimensions of creative music-making; and to offer syntheses pertaining to diverse research domains.

SMS Framework

The initial design and implementation of SMS method imply the conceptual framework with the following interdisciplinary elements: (i) a key word (either the name of scientist or his/her main idea of the fields of innovation), (ii) the cultural heritage of scientific innovation and (iii) some facts of life about scientist.

The framework uses research approach, but with a new new angle for creative imagination for each element. According to Henriksen (2017) design thinking provides a natural bridge between the arts, sciences, and other subjects, thus providing an interdisciplinary crossroads.

Thus, the theoretical background of STEAM SMS is based on research delivered in the form of song where contextual understanding is reached through the means of poetic story linked to the selected scientist, with reflection of pictures (on the idea of his discovery) and imagination. The visual arts (such as pictures, images, video) are involved not only to reflect some ideas, but also provide better understanding if the song is written in language not known to a public.

Results: Apples of Sievers (About the Discovery of Sievers)

A Song-Allegory

The author demonstrates her SMS method on the example of Johann Sievers, a German botanist of the 18th century, who was invited by the Saint Petersburg Academy of Sciences to implement research on plants. He discovered the apple tree (Malus sieversii) in the mountains of Kazakhstan which was proved as the progenitor of all apple trees on the Earth in the 20th century. The song "Apples of Sievers" was awarded the 1st prize of the 2020 International Online Music Festival conducted in Slovenia (in the time of pandemic). The poem is provided with its

translation in English, performed on piano with the illustrated pictures reflecting the context of allegorical and metaphorical song.

The research is based on original, recently published sources, first of all, the book with the Sievers' letters from Siberia (published in 2018). Based on this research, the poem "Apples of Sievers" (Яблоки Сиверса) was created about the German scientist Sievers.

The original verses of song Яблоки Сиверса (in Russian) is provided below both in Russian language (original) and in English:

Яблоки Сиверса (Apples of Sievers)

На горе, где жили сурки, выросла яблоня дивной красоты:
Корни глубоки, триста лет живет, в южной части гор, возле озера растет
Бурые медведи зерна древа разнесли, и вырос яблонь лес в долине у реки,
Прародитель яблок всех ее потомств - древо семиречья стало природы образцом

Яблоки Сиверса счастьем налиты
Вы храните яблоки от дерева-мечты
Яблоко — дитя, а яблоня — семья.
Вечность без начала и символ без конца

Но пришел однажды странный зверь с «яблоком раздора» в яблоневый лес,
И животные всех мастей-пород ропробовали яблоко где был другой приплод
И с тех пор, вдруг, начал чахнуть дивный сад, Алхимика призвали, чтобы он дал свой расклад:
„Каждый пусть посадит яблоню свою с молитвой, светлым помыслом в новую весну".

<u>Translation into English Language</u>

The song Apples of Sievers:

On the mountain where the marmots lived, an apple tree of marvelous beauty grew
Roots are deep, it lives for three hundred years and grows in the southern part of the mountains, near the lake
Brown bears spread grains of the tree, and forest of apple trees grew in a river valley,
The progenitor of apples of all generations, a tree of "seven rivers" became a model of nature
Apples of Sievers are filled with happiness - keep safe the apples from your dream tree,
An apple is a child, an apple tree is a family - eternity without beginning

and symbol without end;
One day a strange beast came with an “apple of discord” to the apple forest, and animals of all “colours-and-breeds” tried an apple with “another offspring”
And since then, the marvelous garden suddenly began dying.
“Let everyone plant his apple tree with a prayer, a bright inspiration for a new spring.”

Demonstration

A song-allegory “Apples of Sievers” with all elements (Poem, Music, Digital Art in the form of pictures) is available on the following link below: https://www.youtube.com/watch?v=i8Nw2nyPTmc&t=24s.

The general duration of time of the first SMS named as “Apple of Sievers” is 3:52 (Link 1) and the second one (about Gmelin, - demonstrated for comparison, - “Road of a Lifetime or Water Water” is 2:44 (Link 2).

“Apples of Sievers” includes the pictures of artist Anna Berezovskaya, and “Water Water” – engravings of the 18th century, including the engravings from the book of Gmelin “Travels through Northern Persia” and “Journey through Russia”.

The demonstration of SMS on YouTube provides clear examples and show freedom in terms different creative elements (for instance, digital images).

First of all, a song, poem and visualization of ideas (through pictures of Berezovskaya, the author of pictures) are all used together – each of them as a separate method of learning and all together - as a joint method of learning (with synergy effects) for the broad audience. Pictures also illustrate either the text and/or the main idea. They are also important if the language is not understood at all, or partially. The author is free to use his/her imagination and select the pictures of artists, painters or the related video.

Second, for the matter of comparison, the other link is given, to compare the SMS about the other German scientist of the 18th century - a German physician, botanist and explorer of the Caspian Sea, - Samuel George Gottlieb Gmelin (4 July 1744 – 27 July 1774) (Link 2). The destiny of both scientists are also connected. Sievers in his book entitled “Letters from Siberia” made the reference for Gmelin’s books.

Below are two examples of both SMS methods and variations (in terms of pictures, music, approach and others)

Link 1: https://bit.ly/3wx5ckA.

Link 2: https://www.youtube.com/watch?v=daiSGLn-0GI

Conclusions

The learning method of SMS revives the great interest of the broad public to the innovations of the past through Science and Arts (S&A) or STEAM approach. The article demonstrates how this method can boost interest towards innovations

in STEM through the example of Sievers, the German scientist of the 18th century. It is designed to integrate science, education and the arts into a synthesis of creativity and innovation. SMS as the artistic method is comparable to the Greek symposium's traditions and fits well under STEAM approach, with its integrated nature of Science and Arts. The demonstrated examples of SMS are based on the Age of Enlightenment, the intellectual and philosophical movement in Europe in the 17th and 18th centuries.

The theoretical background of STEAM SMS is research about scientists and their innovations demonstrated in the creative form of musical ballads. Its methodology is based on experimental design of the author's music and the poetic discourse linked to the research about scientists' heritage. Contextual understanding is delivered through the means of poem and creative visual Art.

The methods of SMS have been applied in more than dozens of songs about the scientists of the 17th-20th centuries (available for free access in YouTube), and can be applied in both teaching and learning methods. These SMS can already be applied as a learning exercise with the key questions: What, how and why? For those who are studying any fields of STEM, the method of SMS can be both learning and teaching method. The lecturer/teacher/professor can use the relevant questions based on these examples for students, public and other groups about innovations: which kind of innovation we are talking about, and which fields of STEM it covers? What is the essence of each particular innovation? How these innovations were initially developed and how this innovation is used today? Why it was developed at that particular time and what was the economic, political, cultural and other conditions? Any questions will bring the interest and additional research by those who want to study STEM: who were those scientists, what they were developing, what was the historical conditions of that time in the listed countries and for these types of innovations and the fields of research. It could be also a special education and interdisciplinary course to be developed with its own curriculum: STEAM, or History of innovations, Design thinking, Art management or others. It could be a great potential for various funded projects with the interdisciplinary, creative, project-based opportunities, and development of games.

The contribution to knowledge is broad: first of all, it includes the original and pioneering synthesis of interdisciplinary expertise (History of innovations, Music and Poetry) with a scientific inquiry - a learning method SMS (Stories based on Music about Scientists). Second, it shows the conceptual framework, the elements, formula, and an algorithm. Third, SMS demonstrates a good algorithm to develop a new interdisciplinary scientific knowledge. Fourth, SMS induces the scientific curiosity and leads to the development of innovations. Fifth, it applies various approaches – from the STEAM (STEM + Art) approach up to gender approach (including girl and woman´s education). Sixth, SMS stimulates a development of new ideas how to popularize SMS with different musical genres – from jazz and blues up to popular music and rock. Seventh, SMS creates a variety of new opportunities - with the inclusions of different creative "adjustments" to each element and for different age groups meeting the different tastes. Eighth, SMS spreads the new ideas for new learning and teaching. Finally, it promotes the European science and European heritage of science and innovation under this new

initiative.

The future areas of its development are the modern ideas which were already demonstrated in the 17th century such as AI, sustainable development, magnetic fields and energy sources. They will be explored through the lines of research investigation in different STEM fields to stimulate discussions on various types of innovations.

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