



STEAM Approach: SMS (Stories Based on Music about Scientists) on Artificial Intelligence Created by Jacob Bruce (1669–1735)

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Abstract:

The proposed theme of this paper is how "Arts" and "Science," with the inclusion of the topic of "Health", can be combined through a story based on research about innovation in the Past. The goal of this paper is threefold. *First*, to present a research-based story about Jacob Bruce (1669–1735), a scholar of Scottish descent born in Moscow, and his innovation – the prototype of Artificial Intelligence, humanoid robot. *Second*, to illustrate the new experimental interdisciplinary method of storytelling - SMS (Stories based on Music about Scientists), a novel approach that integrates Arts (Music, Poem, Digital images), Science (Historical Research about Innovations of the Past), and Culture (cultural heritage with metaphor of a philosophical soul development). *Third*, to explain how this method can be applied. SMS method created in 2012 uses the Avant-garde genre of Music with the integration of interdisciplinary knowledge, holistic approach, and implies a deeper level of integration of various disciplines. The theme of this SMS is a song-story about the beautiful humanoid girl-robot (but with a different technology of the 17th century), which serves as a prototype of the modern homunculus or AI created by Jacob Bruce. AI humanoid already resembled a natural human being by the end of the 17th century. The author explains and discusses how and why SMS can be used as an Innovative Teaching and Learning method, related to Science and Arts (similar to STEAM approach), with the power of Lifelong Learning (LLL), and pedagogical didactics across branches of sciences, thus stimulating innovations and discoveries.

Keywords: Arts and Science; Innovations; STEAM/SMS (Stories based on Music about Scientists) method; Jacob Bruce (1669–1735); Innovative Teaching and Learning; Health



“Only Art and Science can raise men to the level of gods.”

Ludwig van Beethoven (1770 – 1827)

Music is beneficial for everyone, both to cure diseases and to maintain health.

Its power should not be underestimated

Al-Farabi (870-950 AD) (The Great Book of Music)

1. Introduction

1.1. Research: Story-telling about Jacob Bruce, a Scientist of Scottish descent

A central figure in this “new type” of storytelling’s research is Jacob Bruce (1669-1735), who created AI in the 17th century. Jacob Bruce was born in Moscow and descended on his father’s side from the Bruces of Clackmannan in Scotland (Collis, 2012). Bruce’s biographer M.D. Khmyrov (М. Д. Хмыров) emphasizes the encyclopedic nature of Bruce’s knowledge, and writes about him¹: “Astronomer and mathematician, artilleryman and engineer, botanist and mineralogist, geographer, author of several and translator of many scientific works” (Луппов, 1973). Luppov (1973) also added that Count Bruce was the first prominent figure in the field of Russian pedagogy and science of that time, and a companion of Peter the Great (Comments: this name of the tsar is commonly used in the West, while in the East, he is better known as Peter the First, - “Петр Первый”).

The ratio of the number of books on different branches of knowledge in Bruce's library characterizes the area of his primary interests. Noteworthy is the large number of literature on physical and mathematical sciences (233 books), medicine (116 books), geological and geographical sciences (71 books). Bruce was at the forefront of Russian printing, and rich practice in mint reforms (after visiting Isaac Newton in England and discussing it), travelling, the literature on Arts and religions and military sciences (91 books) in artillery, and fortification (Копанева, 2020). He was a leading figure in the Russian science, and the head of mining and industry, the head of the Mathematical and Navigation School based in the Sukharev Tower. Bruce also established the first observatory of Russia on the third floor of this Tower in 1699. **Figure 1** (below) demonstrates his portrait and pictures of the legendary Suharev Tower, where Jacob Bruce worked on his innovations.

Bruce was also one of the leading diplomats, esteemed for his great learning, and Russia’s first Newtonian, who created a housemaid from flowers (Collis, 2012). This housemaid was an android or AI, robot-type girl, created in the Sukharev Tower, who looked like a genuine girl: she cleaned the bedroom, served coffee, but she could not speak. This bears a resemblance to a legend about the medieval alchemist Albertus Magnus, in which he reputedly created an android in his secret workshop (Collis, 2012, p. 53). In medieval and early writings, there are stories about medieval AI or an artificial construct in the shape of a human body animated for the purpose of divination, associated with Gerbert of Aurillac, Albertus Magnus, Robert Grosseteste, Roger Bacon (Kang and Halliburton, 2020, p. 72).

In this story, the author refers to the 17th century time frame which was a crucial period in the development of modern science in Europe. It saw advancements in various fields such as astronomy, physics, mathematics, and biology, and this period is often referred to as the Scientific Revolution. The Royal Society of London for Improving Natural Knowledge, commonly known as the Royal Society, was founded on November 28, 1660, when a group of prominent scientists and philosophers gathered at Gresham College in London. It was granted a royal charter by King Charles II in 1662, officially establishing it as The Royal Society. Similarly, in 1666, Louis XIV established learned societies to encourage the spirit of French scientific research, promoting academic disciplines such as the arts and sciences.

¹ Луппов С.П. Книга в России в первой четверти XVIII в. Л., 1973. Глава пятая. Частные книжные собрания. Translated from Russian, the original text is in the source: <https://www.alib.ru/bouluppov52.phtml>

Сухарева Башня и Яков Брюс the Sukharev Tower and Jakob Bruce: research of 1862

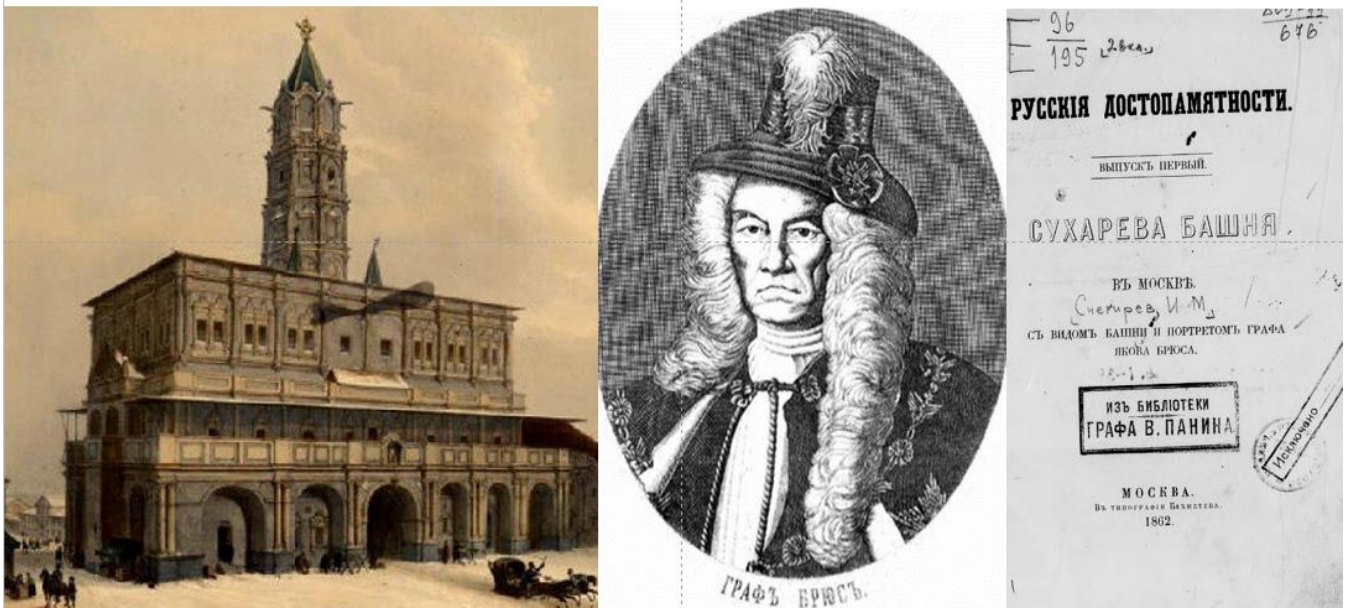


Figure 1. From the left to the right: Photo of Suharev Tower. Portrait of J.V.Bruce by lithography of F. Mayer. XIX century. From the book: Primitive Calendar of Bruce, from the 1st edition during the lifetime of Bruce, with his portrait and biography. Kharkiv, 1875. MAE Russian Academy of Sciences. On the right: Suharev Tower in Moscow (Moscow, 1802).

1.2. **Health:** A healing power of Arts (Storytelling in Poetry, Music, and Virtual Arts)

In this paper, the author introduces the new method of research with a story telling (based on research about Jacob Bruce) - mechanism, which embeds Arts and Science. In facts, it includes many related fields: **Arts, Culture, Science**, Innovations and Health. The applied SMS (Stories based on Music about Scientists) is a novel method, a STEAM approach which integrates **Science** (Historical Research stories about Innovations of the Past), **Arts** (Music, Poem, Digital images), and **Culture** (cultural heritage with metaphor of philosophical soul development). In order to understand these concepts we briefly define them.

- **Stories** are a universal language loaded with symbolism and significance, allowing us to unravel the mysteries of the world: they seek to discover the meaning of human existence and consider our own individual purpose within it (Rooney et al., p. 147).

Kant in "Critique of the Power of Judgment" gives the definition of **Art**, which is defined:

- **Art** is "a kind of representation that is purposive in itself and, though without an end, nevertheless promotes the cultivation of the mental powers for sociable communication" (Adajian, 2007). "The cultivation of the mental power" in this Kant's definition is very important, because of similarities with a broader concept of "**Culture**".

- **Culture** as a word originates from the Latin root "cultura" or "cultus" meaning to "inhabit, cultivate, or honour". Thus, culture includes ideas, language, beliefs, customs, codes, institutions, tools, techniques, works of art, rituals, and ceremonies.

The origins of the word "poem" trace back to the Greek word "poiema," which means "a thing made" or "a creation", and a poet, as defined in ancient terms, is essentially "a maker of things." This concept underscores the creative act of crafting poetry.

- **Poetry** has a special place and meaning in the history of healing: shamans and medicine men and women chanted poems as a part of their *healing art* (Chavis, 2011, p. 19). In ancient Greece, Appolo, the patron God of **music and poetry** (poetry: light, sun and prophecy; drama: inspiration and catarsis for entire community), is also recognised as the divinity of **medicine and healing** (Chavis, 2011), thus, directly linked to "health" issues. Al-Farabi, the Central Asian scientist who wrote on the perfect city, logic, astronomy, linguistics, politics, mathematics, geometry, medicine, optic, philosophy, and music, known as the 'second teacher' (after Aristotle, the first teacher) discussed the importance of **music**



(Nurysheva & Tercan, 2021). Music was not only as an art form, but also as a tool for cultivating the soul and promoting physical and mental well-being in the 9th AD (Nurysheva & Tercan, 2021). Al-Farabi who raised most of his philosophy and theory on Greek philosophers such as Aristotle, Pythagoras and Plato, wrote in his Great Book of Music: - **Music** is beneficial for everyone, both to cure diseases and to maintain health”.

He acknowledges the therapeutic effects of music on the soul and its ability to induce states of calmness and relaxation. Al-Farabi believed that music had the power to influence both the body and the soul, depending on type of music: *rational, ethical, and customary*. Rational music (closely linked to philosophical and intellectual pursuits), had the most profound effect on the soul, leading to intellectual and spiritual development, ethical music aimed to instill virtuous qualities in listeners, and customary music was associated with entertainment and social customs. SMS incorporates the rational music qualities, and might go even beyond it due to the additional and intentional components of Arts and Poetry. Al-Farabi shared the story of 'Alqama ibn 'Abda (sixth century), the poet who was refused a hearing by the Ghassanid king Al-Harith ibn Abi Shamir (529-69) until he had melodized his verse and sung it to him (Farmer, 1929, p.18). Thus, music and arts in the Past played integral roles in promoting health and well-being by addressing the emotional, cognitive, social, and physical aspects of human experience, and contributing to a multitude of additional qualities and abilities.

2. Methods

SMS (Stories based on Music about Scientists) method was developed as a music experiment on a “hobby” research in 2012-2013 years in Europe (Slovenia), with the idea to create the author project “Education for all”, when STEAM approach was not known. Following the inspiring European ideas of Leonardo da Vinci (1452-1519), an Italian Renaissance painter, scientist and inventor with “principles for the development of a complete mind”: “*Study the science of art. Study the art of science. Develop your senses – especially learn how to see. Realize that everything connects to everything else*” (Haesen and Van De Put, 2018, p. 9). Therefore, it was created as the European novel and pioneering approach that integrates Arts (Music, Poem, Visual Arts (digital images), Science (Research about Innovations) and Culture (Language, Ideas, and Beliefs). The author has been using SMS since 2012 year and received 13 awards from the International Music festivals. The author uses this approach with the both components of Arts and Science as a STEAM Ambassador (volunteer in the Deloitte & European Commission’s ESTEAM project) to promote the power of innovations through Arts and incorporate the digital competences of women and girls in STEM disciplines.

2.1 SMS (Stories based on Music about Scientists): Innovative Teaching and Learning method

Storytelling here is present as a Methodological Approach in Research. The other key inspiring method, which is based on a storytelling, is the method of SMS (Stories based on Music about Scientists) which embeds both the Arts and Sciences. The description of SMS method is presented and explained here through: “What (1-2)-Why (3)-How (4-7)” questions. The SMS method has the following conceptual framework:

1. Research about the scientist of the Past time
2. Story about a Scientist-Polymath of the Past time (mainly, the 17th-20th centuries)
3. Key idea of Innovation, its Ethical issue or inspiring facts from the life of Scientist
4. Lyrics (a): written based on research)/or Poem (b) written by Scientist himself with some elements of phantasies (in 3a) or construction of the key shorter version (3b)
5. Music (emphasising the idea of lyrics)
6. Visual Arts (digital images /pictures, video, etc.) to explain the key ideas to those who do not understand the original languages of lyrics (English, Russian, Slovenian, or Latin).
7. Performance (live) or Music Notes or Recording (digital) placed on Youtube/Facebook

There are two types of SMS, which can be used as a method of Innovative Teaching and Learning, the interdisciplinary method with the intersection of Arts and Science:



- First type of SMS – written based on research with the initial poem about scientist of the Past time based on research facts about the life of scientist or his innovation
- Second type of SMS – written based on the poem of scientist himself (his original song), and the composed music is added to the poem with the digital images

The project “Heritage of Science” in “Education for All” is a personal author’s artistic non-funded initiative, which was set up as an attempt to share the knowledge about Science through the poetic stories about scientists of the past centuries based on the volunteering author’s research. The author promotes the power of Science and Arts in the method SMS (Stories based on Music about Scientists) which can be used as Innovative Teaching and Learning method (the Bologna initiative), Life-Long Learning technique and a holistic and health approach.

2.2 SMS (Stories based on Music about Scientists) vs. STEAM approach

The SMS principle was developed independently, and approximately at the same time as the STEAM approach was developed in the United States (in about 2013, described in the history of its development in “STEM to STEAM” (Istieulova, 2022)). STEAM (science, technology, engineering, the arts and mathematics approaches to education have been recently launched in the EU to improve the relevance and quality of higher education with a holistic and dynamic educational experience with integration of concepts and methods from multiple disciplines, fostering interdisciplinary learning. The European Commission is championing the STEAM approach through the work of the EU STEM Coalition and the actions outlined in the European Skills Agenda.

In 2013, John Maeda, the founder of STEAM, an Asian American computer scientist, educator, and professor at the MIT Media Lab, answered the question: “What does it mean to add Art to turn STEM into STEAM?” (Lamont, about 2013) He announced that art and design transform the American economy, and the STEAM movement is an opportunity for America to sustain its role as an innovator of the world through 'problem-solving, fearlessness, and critical thinking' (Maeda, 2013).

3. Results

The Romance about Alchemist (with the dedication to Jacob Bruce) – is the title of SMS, and this song was written in Spring, 2015. It has the following elements:

1. Historical research about Jacob Bruce on AI of the Past time, but different technology with the additional elements of phantasy related to the “technology of creation” (which is a “black box”) suggesting that one element was made with the inclusion of cultural heritage (Slovenian Neanderthal flute, about 60-67 mln. years, the oldest instrument): https://www.youtube.com/watch?v=EaN_NLOvYb0
2. Inspiring Story about a Scientist-Polymath of the Past time who introduced innovation.
3. Key idea of Innovation (AI in its perfect form) and its Ethical issue in transformed into the SMS (song) entitled “Romance about Alchemist”.
4. Lyrics (a): written based on research with some elements of phantasies dedicated to the act of woman’s creation. For instance, in a poem, there was a metaphor to depict the creation of woman through musical performance on the ancient flute (referring to the Neanderthal flute, the oldest instrument in the world, found in Slovenia).
5. Music (emphasising the idea of lyrics) – Musical Notes (below, the introduction).
6. Visual Arts (digital images /pictures, video, etc.) – should be published in YouTube channel (author/under her other name of Aleona von Sultanova – used in Music/SMS): <https://www.youtube.com/channel/UCI2j8TiTOj1cwQpHWD8Ngg>
7. Performance (live, in the hostel Celica), and/or Music Notes <https://www.facebook.com/1346167803/videos/pcb.10220238261770494/10220238242370009>. Typically,

The link presents a live performance, dedicated to the memory of Ljuben Dimkaroski, a dear friend, and musician, who played tidldibab, as he wished to call it or the oldest Neanderthal flute (which was found in Divija baba, Slovenia). The act of creating the artificial 'Jashkina Baba' (or AI of the 17th century, a girl-android) is described in the song, where



one of Jacob Bruce's rituals involved playing the oldest instrument (the oldest flute), hence the numerous analogies. Although there are some elements of phantasies, but they are also linked to some legends and real stories. Ljuben Dimkaroski, shared one of the real stories. During his interview in 2015 to the author of this article, he shared a story, that after 2.5 years of having the replica of this flute in his apartment in Ljubljana, during one night, he saw himself in the night dream. In that dream, someone was showing to him how to play this ancient flute (from the bone).

It should also be noted, that the concept of AI is broader than that of a robot, and the concept of a robot is broader than that of an android, which specifically refers to robots designed to resemble humans. Thus, according to these three concepts, it would probably be more precise to use the term 'android' for a humanoid robot. At the same time, the author uses the general term AI to illustrate that AI models could be more advanced in the 17th century compared to those created today, yet ethical questions remain the same. The text of SMS lyrics is provided below:

Романс об Алхимике (Romance about Alchemist)

В конце 17-го столетья алхимик формулу искал:

Искал он формулу совершенства, чтобы создать свой идеал.

Мечтал увидеть он новый облик – свой женский Евы идеал,

Спускаясь с башни в пещеру, алхимик романс свой тайный напевал:

Припев:

Как вверху, так и внизу, как сейчас, так и тогда,

При полной луне и в маске от блаженства

Как Парацельс, сотвори ту алхимию любви

И прошепчи ты формулу Трисмегиста.

Что такое душа? Как ее сотворить?

Духов ты вызывал, с ангелами говорил,

книгу Еноха читал, в шар хрустальный смотрел,

Мудрости меч рассекал, и душой постарел:

Чернокнижником став, золото из меди создав,

омолодив живою водой о сокровенном мечтал,

Чтобы душу вдохнуть – это не плоть омолодить:

равносильно творцу то уметь творить

Из рая иль ада, и что же ты создал?

И формулу жизни вложил в свой идеал,

Глаза - как изумруды, копна волос в цветах.

Восточные глаза и совершенный стан.

Но образ твой прекрасный немой и без души,

И ты не знаешь точно, что чувствует внутри,

И движется прекрасно, и кофе подает, -

улыбка ж безучастна, глаза ее грустны.

Книга Соломона указала некий знак,

Фиалками и розами гомунгул осыпал,

И каплями росы и дуновением весны

и, до сих пор, ты поисках алхимии души

Маг и алхимик славянской страны,

Древнюю флейту в руки возьми

И совершенство ты сотвори:

В танце суфиста движенье планет пробуди, прошептав:



Припев:

Как вверху, так и внизу, как сейчас, так и тогда,
При полной луне и в маске от блаженства
Ты во сне увидал, как играть на флейте той,
При полной луне на восток в танце суфиста.

Romance about Alchemist (translated in English language).

At the end of the 17th century, an alchemist sought a formula:
He searched for perfection to create his ideal.
He dreamed of witnessing a new manifestation - his feminine ideal of Eve.
Descending from the tower into the cave, the alchemist sang his secret romance:

Chorus:

As above, so below, as now, so in the Past,
Under the full moon wearing a mask of bliss
You, like Paracelsus, create that alchemy of love
And whisper the formula of Trismegistus.
What is the soul? How does one create it?
You called upon your spirits and conversed with angels,
You delved into the book of Enoch and gazed into the crystal ball,
You cleaved the air with the sword of wisdom, yet your soul aged further:

You became a warlock, transmuting copper into gold, rejuvenated by living water,
You dreamed of the internal secret:
to 'breathe in' a soul is not to rejuvenate your flesh
but to embody the Creator's ability to create
Whether from heaven or hell, what have you created?

And he infused the formula of life into his ideal:
Her eyes akin to emeralds, a head adorned with lovely flowers,
Oriental eyes and a perfect figure.
Yet your beautiful image is mute and soulless,
And you do not understand what resides within.
It moves gracefully and serves coffee, -
Her smile is indifferent, her eyes are sad.

The Book of Solomon indicated a certain sign,
you showered the homungul with violets and roses,
with drops of dew and a breath of spring and, somewhere there,
you are still in search of the alchemy of the soul

Magician and alchemist of the Slavic lands,
take the ancient flute in your hands,
and strive for perfection:
In the dance of a Sufi, awaken the movement of the planets, whispering:

Chorus:

As above, so below, as now, so in the Past,
Under the full moon and wearing a mask of bliss,
In your dream, you saw how to play the ancient flute of the one
With the full moon to the east in a Sufi dance.



Romance about Alchemist

Intro $\text{♩} = 236$ Words & Music by Yelena Istieulova

Bb/D A Dm

Piano

5

10 E|ma|j7 Abm

14 B7

Pno.

Figure 2: Excerpt from the Introduction of the Musical Composition on Jacob Bruce (Romance about Alchemist).

4. Discussion

In the modern higher education of the third decade of the 21st century there are a lot of attempts to integrate STEAM approaches in the inter- and transdisciplinary higher education through developing a comprehensive methodological framework through, speculative design, art thinking, process-based research and participatory practice and the methods to implement STEAM pedagogical approaches (Carter et al., 2021). The SMS method is easily associated with the STEAM approach. However, the STEAM approach does not incorporate methods similar to SMS.

According to discussions by Carter (2021), HEIs refer to the ideal approach to STEAM, which is (potentially) involving:

- a culture of the Arts and Sciences on an equal footing
- operating within a process-driven paradigm, student-centred, holistic



- being collaborative, diverse and delivered through safe spaces
- establishing a mind of openness, reflection, experimentation and curiosity
- generating qualities that promote learning, cooperation and multi-modality
- supporting transdisciplinary practices and emphasise prototyping
- developing competencies of critical thinking, creativity and communication whilst investigating how to generate solutions.

The SMS method easily meets all the criteria set forth by prominent HEIs. It is the Avant-garde & Experimental genre of music which embeds the key fields of knowledge: Science (History of Science/Historical research), Arts (Music, Poetry, and Digital Images), and Culture (Language, Ideas, Beliefs). Additionally, it aligns with innovative teaching and learning methods, as well as lifelong learning (LLL) practices, which can be associated with STEAM Ambassadorship. Returning to the elements of art and science cited by Beethoven, when music contributes to health benefits and the cultivation of mental faculties for social communication, as an element of culture, along with music and poetry, provides a holistic approach. Rational music, with its power to influence both the body and the soul through philosophical and intellectual pursuits, leads to intellectual and spiritual development. Further effects is to be studied through Al-Farabi and Avicenna, who wrote about the influence of music on health, including its effects of curiosity and stimulation for new discoveries in science.

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