



PERSONALISED LEARNING THROUGH THE SCREEN: EXAMINE *SAILOR MOON* TV SERIES AS STEM-BASED ANIME

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ABSTRACT

Sailor Moon is a popular anime TV series dominated entertainment culture for over 20 years. Despite providing children with fictional and informational content, this anime TV series also indirectly create a personalised learning environment for children. Even though most of the anime produced has been inspired by the STEM element, the indicator to classify the respective TV series as STEM-based anime is still undiscovered. This study uses a qualitative approach through content analysis. Thirty-two episodes and two feature movies from the reboot version of *Pretty Guardian Sailor Moon Crystal* have been watched for research analysis. Content analysis has been conducted by extracting any observable data in a textual form. The textual data have later been coded into their respective themes for triangulation and interpretation. The result shows that *Sailor Moon* can be classified as STEM-based anime based on the three discovered indicators. The three indicators strongly portray the astrology of the planetary solar system as a STEM element, STEM visual design and representation, and potential STEM learning outcomes. Despite the educational value, this paper will provide the fundamental discussion for scholars, media TV producers or possibly teachers to look at the specific criteria to examine and classify any media entertainment, particularly anime series as “STEM-based anime”.

Keywords: *Sailor Moon*; STEM-based anime; STEM education; personalised learning; children's entertainment

INTRODUCTION

Television is part of media entertainment among children that provide a personalised learning environment. It also serves several educational values for audience. The number of media entertainment producing a variety of anime series is higher. They targeted mainly audience among children. Children in the 90's were engaged with television series. Despite the humanitarian moral value integrated into the series, the STEM element is part of the content inspired to create a fictional character in particular anime series. *Sailor Moon* is one of the anime series inspired by the STEM element, which consist of planetary solar system concept. The series is dominated by girls as compared to the boys. *Sailor Moon* is represented as a beautiful guardian that protected the Earth from monsters and evil. This powerful character fantasized about the children impersonating the *Sailor Moon*. Despite the love and friendship moral value, the *Sailor Moon* series help to personalise the learning of planetary solar system concept. This series has lasted in popularity for over 20 years all over the world (Toku, 2015). *Sailor Moon* is one of the best examples to illustrate the idea of STEM-based anime. *Sailor Moon* is one of the popular anime series of the 90s. This anime started as *Shōjo manga* (girl's comic) written and illustrated by Naoko Takeuchi from 1991 to 1997.

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Upon its popularity, manga adapted her works into an anime series. The series was produced by Toei Animation. The original series was produced from 1992 to 1997 with the original version of "Pretty Guardian Sailor Moon" through five series (*Sailor Moon* - 46 episodes; *Sailor Moon R* - 43 episodes; *Sailor Moon S* - 38 episodes; *Sailor Moon SuperS* - 39 episodes; and *Sailor Moon Sailor Stars* - 34 episodes) and 3 movies which are *Sailor Moon R: The Movie*, *Sailor Moon S: The Movie* and *Sailor Moon SuperS: The Movie*). Later on in 2012, Kondansha and Toei Animation announced that they will produce the reboot simultaneous version of a new adaptation of *Sailor Moon* for the 20th anniversary of the anime series. They rebranded it as "Pretty Guardian Sailor Moon Crystal" through three series (Season I: Dark Kingdom - 14 episodes; Season II: Black Moon - 12 episodes; and Season III: Death Busters - 13 episodes) and 2 movies (*Sailor Moon Eternal* Part 1 and *Sailor Moon Eternal* Part 2). The following sequel movie for *Sailor Moon Cosmos* Part 1 and 2 is still under production process and estimated release by 2023.



Figure 1. *Pretty Guardian Sailor Moon Crystal Season III* official poster produced by Toei Animation.
Source: (Kon, 2016)

The story of anime has a major influence on creativity. As a creative audio-visual artwork, the story had been influenced or adapted by several inspirational elements. As STEM has many various concepts, it is easy to get inspired by these elements. *Sailor Moon* uses the concept of 9 planetary systems and horoscopes to develop each sailor guardian character. Each character has developed their own specific individual character and personality. The visual appearance has been portrayed as pretty guardians with special power, purposely to protect the earth and the universe from dark, evil and monsters. The strong bond of love and friendship among each character makes the series more engaging for young girls. Despite inspiring the girl to be stronger, the symbol and fictional representation of the planetary system through each *sailor* guardian's character, indirectly helps children to relate and memorise the name of planetary system.

Initiative and inspiration by Japanese anime to apply some STEM concepts into artwork series is a good strategy to enculture STEM. As media entertainment through a comic or TV shows has dominating audience especially among youngsters, exposing them to some STEM concepts help them to recall their pre-existing scientific knowledge. This is beneficial as this form of media entertainment can be use during leisure time (Wan Nor Fadzilah et al., 2017), which means outside the classroom context. Enculturing STEM education is

one of the strategies to sustain the STEM environment, especially at the early age of child development (Ishak et al., 2021; Ishak et al., 2022). STEM education is the major focus of the educational system. It is to ensure the sustainability of technology and economic development of each developed country. With the power of animation, the STEM-based concept can be adapted to various fictional storylines that might attract youngsters. Throughout the decades, *Sailor Moon* is one of the worldwide popular anime series that uses STEM concepts (astrology of planetary solar system) as the core for designing character and storyline structure.

Through anime TV series, it helps to create a personalised learning environment for children. Children have some pre-existing STEM knowledge. They learn most of the STEM scientific concepts at school through textbooks. This knowledge is stored in their mind as existing knowledge. In a constructivist theory, Jean Piaget (1974) suggests that children tend to make connection and relate it through observation with the existing knowledge when exposed to any scientific concept in their surroundings. This situation triggers the learning process where the children make their understanding based on the pre-existing knowledge. This kind of learning approach is part of personalised learning. Anime series on television are non-interactive, yet it still provides a personalized learning environment where the children have the opportunity to reflect upon their learning through observation.

Discussion on *Sailor Moon* has been done in most media entertainment studies. The study on media entertainment rarely identifies and discusses this type of anime or any cartoon as its suitability to represent STEM education. Most of this discussion only being discussed in various open online forum discussions. There is a large number of STEM-based anime has been produced up until now. Some anime and manga fans have been found to rank a few exciting anime that explores the world of science, as mentioned in Ranker and CBR.com (Lindwasser, 2019; Rose, 2022). Although that recent anime has caught attention among anime fans, *Sailor Moon* on the other hand was the pioneer series that has the STEM-based concept inspired by astrology. The *Sailor Moon* (2014-2021) series have been rebooted and remade for the 21st-century series version. Most studies conducted mainly discussed *Sailor Moon* on its character design (Newsom, 2004; Thongprasert, 2021), narratology and visual storytelling (Dentice, 2022), influence on fashion and cosplay, affirmation issue of feminism and LGBT (Ashley, 2018; Cockerill, 2019; Orbaugh, 2021; Robinson, 2021) perspectives. However, the academic discussion on *Sailor Moon* as STEM-based media entertainment for STEM enculturation is still limited.

Hence, this paper will full fill the gap to study on how the popular anime series *Sailor Moon* can be described as STEM-based anime. To operationalise this idea, this study defines STEM-based anime as Japanese TV animation series that has been developed for entertainment purposes with the integration of STEM concepts into the character and plot design of the overall artwork masterpiece. This paper mainly seeks fundamental answers on why *Sailor Moon* is suitable for exposing youngsters to the planetary solar system as part of STEM education.

METHODOLOGY

This study is a fundamental research. The lack of brief discussion to classify STEM-based anime led this study to use a qualitative approach. Content analysis is being applied as a method used to gather all data. Since the reboot version of *Sailor Moon* has a similar storyline but shorten in the plot structure, this study uses the latest reboot version of *Sailor Moon* which is "Pretty Guardian Sailor Moon Crystal" as the main sample. The series is obtained from online streaming through iQIYI and Netflix. All these audio-visual sources were watched through online streaming via iQIYI (https://www.iq.com/album/pretty-guardian-sailor-moon-crystal-2014-1toll2har31?lang=en_us) and Netflix (upon subscription).

The entire story needs to be observed and watched. A total number of 39 episodes from the "Pretty Guardian Sailor Moon Crystal" series and 2 movies have been watched. The key aspect to be examined are the adaptation of the main STEM element, how the STEM element is being designed as a storyline; and STEM content should be learned. All data were gathered in textual form. Every key point observed through the process has been recorded as research notes. All textual data will be grouped based on the specifically identified themes (STEM

element; Visual design; and learning output). As part of the qualitative approach, the textual data has been interpreted by the researcher and triangulated with the visual evidence from the samples.

RESULT AND DISCUSSION

The data obtained by qualitative content analysis shows that *Pretty Guardian Sailor Moon Crystal* has the underlying basis of the solar system concept. Solar system is part of STEM which is a branch of Astronomy. In relation to STEM, astronomy is a branch of science. However, the study of astronomy can be done in many other ways aside from just observing from the earth surface. It requires a specific technology designed and developed in order to observe the clear picture of the outerspace through our eyes. Calculation also involves studying the distance of each planet. Entertainment industries are aware about this and try to influence viewer (children) to get inspired by those STEM basis, one of them is through *Sailor Moon* creation. *Sailor Moon* is a fictional Shōjo manga written and designed for girls. Naoko Takeuchi has a strong interest in astrology and fashion. When writing original comic series for *Sailor Moon*, she integrates her interest on astrology and build a character based on the solar system. Since astrology is the believe of astronomical phenomena (cosmic objects) that have power to influence our daily event, life, and personality traits (Stierwalt, 2020) with the apparent positions of our planets and constellations, Naoko Takeuchi created a story of 10 Sailor guardian protecting universe from dark, evils and monsters.

The appearance and physical look of these 10 Sailor Guardians in *Pretty Guardian Sailor Moon Crystal* are illustrated as tall and beautiful young women. They are all reincarnated as human and awaken to realise that the purpose of reborn is to protect Earth and universe from the evil and monsters. *Sailor Moon* is the main leader of the group and destined to be the Queen of Moon Kingdom in 30th century. At the present time, the other eight sailor guardian named as Sailor Mercury, Sailor Mars, Sailor Jupiter, and Sailor Venus are the inner space Sailor Guardians while Sailor Uranus, Sailor Neptune, Sailor Pluto, and Sailor Saturn are the outer space Sailor Guardians who fight alongside and protect their future queen (*Sailor Moon*). Another character which is the new member of Sailor Guardian named as *Sailor Chibi Moon* is a *Sailor Moon*'s daughter comes from the 30th century. They live as normal human and able to transform with the cosmic power to fight with evil and monsters. The outfit of these Sailor guardian were inspired by *Seeraa-fuku*, a school wear uniform for girls.

The story of *Pretty Guardian Sailor Moon Crystal* anime series represent characters inspired by our planetary solar system. Obviously, the inner and outer sailor guardians are named based on each planet. The series at present time still did not include Earth as one of the members of *Sailor Guardian*. Through the *Pretty Guardian Sailor Moon Crystal* series, Tuxedo Mask also named as *Endymion* plays a character of prince and protector of Earth. However, there is one character named Naru Osaka, who is curious about Usagi (*Sailor Moon*) since the beginning of episode. She also is a good friend of Usagi. Naru Osaka made the first appearance as *Sailor Earth* in *Sailor Moon Omega* and *Sailor Moon Omega Returns*, but this comic series has not been filmed yet. Hence, by examining the series of *Pretty Guardian Sailor Moon Crystal*, the data shows that this anime series is a STEM-based anime due to three major values that can be retrieved which are 1) STEM content, 2) STEM fictional visual representation, and 3) STEM concept can be learn.

STEM Content

The whole concept of *Pretty Guardian Sailor Moon Crystal* was inspired by solar system. As part of astronomy, solar system is a gravitationally bound system in space formed 4.6 billion years ago. The system describes a bound system of Sun and other objects on its orbit (Figure 2). Solar system consists of eight planets. These planets are categorized by NASA as inner terrestrial planets (Mercury, Venus, Earth, and Mars) and outer planets (Jupiter, Saturn, Neptune, and Uranus) (Figure 3). However, in 2006, another planet in solar system was discovered and International Astronomical Union named it as Pluto. Pluto is the ninth planet and consider as dwarf planet (NASA, 2022; Vorderman, 2012). Other than that, moon also known as natural satellites in solar system. Every major planet (Earth, Mars, Jupiter, Saturn, Neptune, Uranus, and Pluto) in solar system has its own moon except for Mercury and Venus.

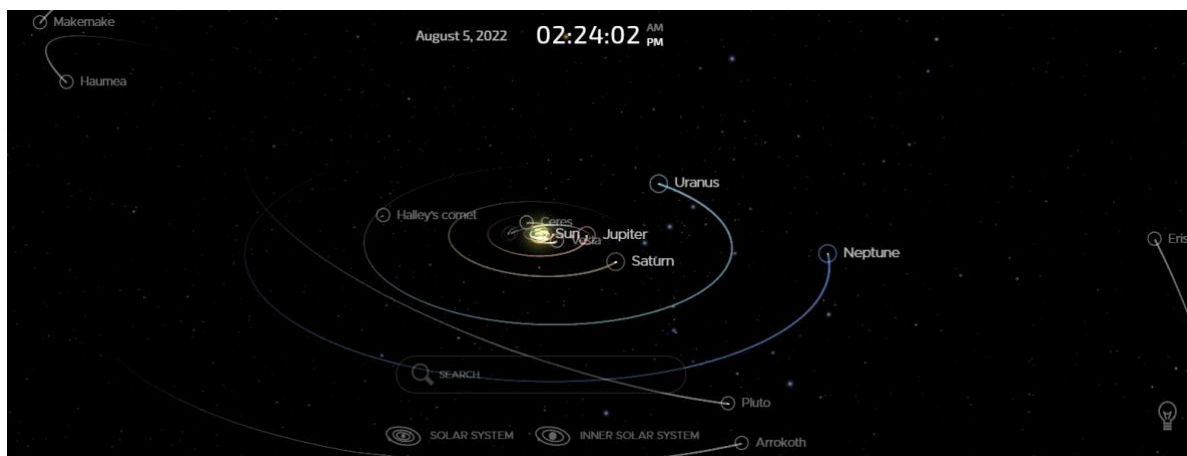


Figure 2. Solar system exploration by NASA's eyes (NASA, 2022).



Figure 3. Primary planetary solar system (NASA, 2022).

In *Pretty Guardian Sailor Moon Crystal* anime series, the Moon and other nine planets were used as inspiration (input) for the character and story development. With the element of fictional and fantasy, the planetary solar system has been represented by each fictional characters who are the princess and prince of their own planet in the past life and reincarnated, named as *Sailor Moon* (princess of Moon), *Sailor Chibi Moon* (*Sailor Moon*'s daughter with *Tuxedo Mask* in 30th century), *Sailor Mercury* (princess of planet Mercury), *Sailor Mars* (princess of planet Mars), *Sailor Jupiter* (princess of planet Jupiter), *Sailor Venus* (princess of planet Venus), *Sailor Uranus* (princess of planet Uranus), *Sailor Neptune* (princess of planet Neptune), *Sailor Pluto* (princess of planet Pluto), *Sailor Saturn* (princess of planet Saturn), the only male character in the team *Tuxedo Mask*

(prince of planet Earth). Even though, the mysterious universe are still under debate among scientist (Lloyd-Ronning, 2022; Space.com, 2012; Tapia, 2021), this anime series portrays other mystery planet in our universe as home for dark, evil and monsters that are trying to take over Earth, a home where the planet shines with beautiful moon and through the power of love, friendship, and humanities.

Fictional Visual Representation of STEM Content

Pretty Guardian Sailor Moon Crystal use planetary solar system and astrology as the main course of inspiration. This STEM content inspiration has been adapted by Naoko Takeuchi to develop each specific main character's physical appearance and personality for the entire storyline. Each character were princesses and *Sailor Guardian* of solar system and reincarnated as human on Earth, a home planet. As princesses and prince from their original planet, the astrological symbolism determined by their birth months has shape each character's personalities throughout the story. Upon reborn as human, their original soul later has been awakened soon realised their purpose of reincarnation is a mission to protect *Sailor Moon* (the future Queen of Moon Kingdom) and Earth from evil. The awakened power has enable them to transform into a *Sailor Guardian*.

a) *Sailor Moon* representing the Moon

Sailor Moon is a female reborn as Tsukino Usagi on June 30th. She is the princess of the Moon Kingdom by *Queen Serenity* during the Silver Millennium. She is illustrated with a slim figure, blue eyes, and porcelain skin with long blonde hair that she wears in double pigtail buns style (*odango*) (Figure 4). *Sailor Moon* is protected by the power of Moon and ruled by astrological sign of cancer. In the story, *Sailor Moon* is a school student who loves sleeping. She is emotional, sweet, romantic, and uses crying as superpower. She uses the power from crystal of Moon and often wins all the battles with the sensitive side. As ruled by Cancer, she is portrayed as hyper emotional, temperamental, and spiteful, but place a high value on family and close friends. She always come off as soft, but a super powerful force to be reckoned. Other than that, she has deep feeling to provide love and forgiveness towards others. As the leader of the *Sailor Guardian*, *Sailor Moon* able to reunite each of *Sailor Guardian* becoming a big working team to fight alongside to defeat evils. She is also closest to *Luna* (a reincarnated black coloured female cat with moon sign on the forehead).



Figure 4. Character design for *Sailor Moon* (left) and Moon (right)

b) *Sailor Chibi Moon* represents the Moon

Sailor Chibi Moon is a daughter of *Sailor Moon* (*Neo-Queen Serenity*) and *Tuxedo Mask* (*King Endymion*) in the 30th century named as Chibiusa Tsukino. She was born on 30th June. She came to the present time to seek for help from the *The Black Moon Clan's* attack rendered the *Inner Sailor Guardians*. She joins the *Sailor Guardian* team as sailor junior apprentice. *Sailor Chibi Moon* has pink hair, red eyes, and wears her hair in *odango* but styled to look like a rabbit's ears (Figure 5). In the 30th century, she is 903+ years old but stagnated in growth. She uses the power from crystal of Moon and ruled by astrological sign of Cancer. Same as *Sailor Moon*, her character almost similar but she used to be distance (due to her physical growth problem) and annoying to *Usagi*. Along the way of her joining the *Sailor Guardian* on the present time, she adored and admire on how *Sailor Moon* become the powerful *Neo-Queen Serenity* also her mother in 30th century. She is also closest to *Diana* (a grey coloured young cat and daughter of *Luna* and *Artemis* in 30th century).



Figure 5. Character design for *Sailor Chibi Moon* (left) and *Moon* (right)

c) *Sailor Mercury* represents the planet Mercury

Sailor Mercury is a female reborn as Ami Mizuno on September 10th. She is the princess of planet Mercury (the planet of water) and guardian of wisdom (Figure 6). *Sailor Mercury* is being illustrated as teenage girl with blue eyes and dark blue hair that reaches her neck. She uses the power from crystal of planet Mercury to transform into *Sailor Mercury*. As born and ruled by astrological sign of Virgo, *Sailor Mercury* has been illustrating as humble, self-effacing, industrious, and practical. However, under the surface, she is frequently natural, kind, and sympathetic. She is also quick thinker and genius among the Sailor Guardian and use her intelligent as weapon. She always has the eye for details, and an analytical outlook while analysing the present of evil and monsters using high-tech devices (mercury goggle and super compact computer). Her main attacks are *mercury aqua mist*, *shine aqua illusion*, and *mercury aqua rhapsody*.



Figure 6. Character design for *Sailor Mercury* (left) and planet Mercury (right)

d) *Sailor Mars* represents the planet Mars

Sailor Mars is a female reborn as Rei Hino on April 17th. She is the princess of planet Mars (the planet of fire) and guardian of war (Figure 7). *Sailor Mars* is being illustrated as a teenage girl with long black hair and blue eyes (sometimes coloured in purple). She is also a shrine priestess and live with her grandfather in temple. That makes her partake the psychic predictions that come from studying the flames. She uses the power from crystal of planet Mars to transform into *Sailor Mars*. As born and ruled by astrological sign of Aries, *Sailor Mars* has the personality of passionate, motivated, and confident leader that make her always quick to fight, share her opinion, and protect her friends. Her main attacks are *Akuryo Taisan*, *Burning Mandala*, and *Mars Snake Fire*.



Figure 7. Character design for *Sailor Mars* (left) and planet Mars (right)

e) *Sailor Jupiter* represents the planet Jupiter

Sailor Jupiter is a female reborn as Makoto Kino on December 5th. She is the princess of planet Jupiter (the planet of thunder) and guardian of protection (Figure 8). *Sailor Jupiter* is illustrated as teenage girl who has a fair skin, slim complexion, big green eyes, and slightly more muscular compared to other fellow *Sailor Guardians*. She also has a long reddish brown wavy hair usually keeps tied up with a ponytail. Although she has a tough physical appearance, she loves gardening and cooking. She uses the power from crystal of planet Jupiter to transform into *Sailor Jupiter*. As born and ruled by astrological sign of Sagittarius, *Sailor Jupiter* has the personality of risk-takers, adventurers, sports mentality and have a sharp on business. Her main attacks are *Flower Hurricane*, *Jupiter Thunderbolt*, *Supreme Thunder*, and *Jupiter Coconut Cyclone*.



Figure 8. Character design for *Sailor Jupiter* (left) and planet Jupiter (right)

f) *Sailor Venus* represents the Planet Venus

Sailor Venus is a female reborn as Minako Aino on October 22nd. She is the princess of planet Venus (the planet of beauty) and guardian of love (Figure 9). She is illustrated as a teenage girl with blue eyes and blonde hair. Often prefer to wear her hair down with a simple red bow. She made a first appearance as *Sailor V* to fight against the *Dark Agency*, before joining the *Sailor Guardian* team. She is closest to *Artemis* (a reincarnated white coloured male cat with moon sign on the forehead). As born and ruled by astrological sign of Libra, *Sailor Venus* has the personality of cosy, extroverted, and friendly type people. She uses the power from crystal of planet Venus to transform into *Sailor Venus*. She is also the leader of inner *Sailor Guardians* because of her tendency to easily make friends and dissolve conflicts. Her main attacks are *Venus Love-Me Chain*, *Rolling Heart Vibration*, and *Venus Wink Chain Sword*.

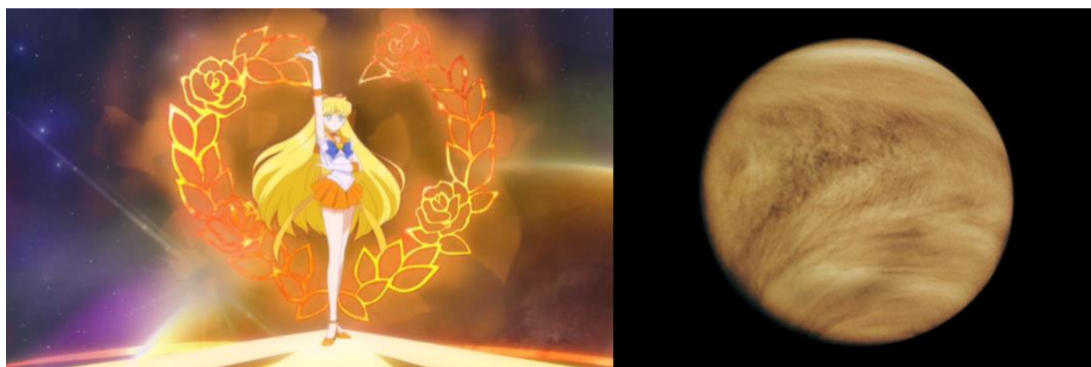


Figure 9. Character design for *Sailor Venus* (left) and planet Venus (right)

g) *Sailor Uranus* represents the planet Uranus

Sailor Uranus is a female reborn as Haruka Tenou on January 27th. She is the princess of planet Uranus (planet of the sky) and guardian of flight (Figure 10). She is illustrated as a teenage high school girl with androgenous appearance, more towards boys. She is a tall girl with dark blue eyes and short pale blond hair and active in car race competition. She lives with Michiru Kaiou and Setsuna Meiou to raise reincarnated Hotaru Tomoe (*Sailor Saturn*). She uses the power from crystal of planet Uranus to transform into *Sailor Uranus*. *Sailor Uranus* owns one of the three Talisman of outer solar system, a space sword. As born and ruled by astrological sign of Aquarius, *Sailor Uranus* has the personality of optimistic, self-reliant, advanced, clever, and exceptional. Her main attacks are *World Shaking*, and *Space Sword Blaster*.

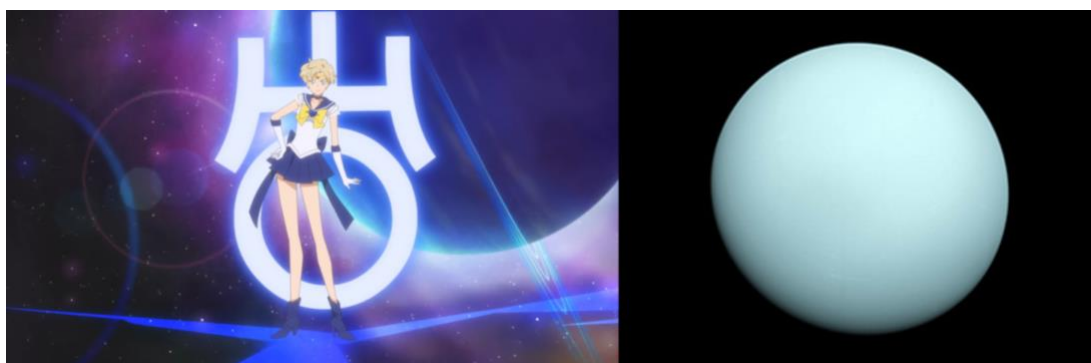


Figure 10. Character design for *Sailor Uranus* (left) and planet Uranus (right)

h) *Sailor Neptune* represents the planet Neptune

Sailor Neptune is a female reborn as Michiru Kaiou on March 6th. She is the princess of planet Neptune (planet of deep blue sea) and guardian of embrace (Figure 11). She is illustrates as slim figure and average height, with deep blue eyes and wavy teal turquoise coloured hair that falls just past her shoulders. Her extreme beauty and delicate-looking girl represent the epitomes of elegance and femininity. She is also a great and world-known pianist. She lives with Haruka Tenou and Setsuna Meiou to raise reincarnated Hotaru Tomoe (*Sailor Saturn*). She uses the power from crystal of planet Neptune to transform into *Sailor Neptune*. *Sailor Neptune* owns one of the three Talisman of outer solar system, a deep aqua mirror. As born and ruled by astrological sign of Pisces, *Sailor Neptune* has the personality of emotionally sensitive, gracious, and emotionally aware that make her appear to be sophisticated, elegant. Although, sometimes having a cold and capable of sharp anger. Her main attacks are *Deep Submerge* and *Submarine Reflection*.



Figure 11. Character design for *Sailor Neptune* (left) and planet Neptune (right)

i) *Sailor Pluto* represents the planet Pluto

Sailor Pluto is a female reborn as Setsuna Meiou on October 29th. She is the princess of planet Pluto (planet of space and time) and guardian of revolution (Figure 12). She is illustrated as a college student (mostly working in science laboratory) with red eyes, knee-length dark green hair partly tied up in a high bun and the rest freely hanging down. Her skin is slightly darker compared to other *Sailor Guardians* and have special relationship with Chibiusa and the purpose of her reincarnation is to continue mission to protect Space-Time-Door as assigned by Neo-Queen Serenity in 30th century. She lives with Haruka Tenou and Michiru Kaiou to raise reincarnated Hotaru Tomoe (*Sailor Saturn*). She uses the power from crystal of planet Pluto to transform into *Sailor Pluto*. Despite of owning the space-time key, *Sailor Pluto* owns one of the three Talisman of outer solar system, a garnet orb and rod. As born and ruled by astrological sign of Scorpio, *Sailor Pluto* has the personality of discreet, secretive with mystery around them that suit her to be the guardian of space and time. Her main attacks are *Death Scream* and *Chronos Typhoon*. She also has the power of *Time Stop*, where causing of her death if using it.



Figure 12. Character design for *Sailor Pluto* (left) and planet Pluto (right)

j) *Sailor Saturn* represents the planet Saturn

Sailor Saturn is a female reborn as Hotaru Tomoe on January 6th. She is the princess of planet Saturn (planet of silence) and guardian of ruin and birth (Figure 13). *Sailor Saturn* reincarnated as Hotaru and raised by her father. After an accident, the father saved her by replacing Hotaru's limb with machine. Due to the sickness, she was always being bullied, until Chibiusa found and feel the deep connection with her. *Sailor Saturn* was awakened by the three Talismans own by *Sailor Uranus*, *Sailor Neptune* and *Sailor Pluto*, despite on her body's explosion. She gives her power to *Super Sailor Moon* and reborn again. Michiru, Haruka and Setsuna raise up Hotaru until another awaken. She has a rapid growth and awaken as *Sailor Saturn* to save *Sailor Moon* and *Tuxedo Mask* from dark spell by *Queen Nehellenia*. She has been illustrated as a petite girl with violet eyes, pale skin, and short dark purple hair. She uses the power from crystal of planet Saturn to transform into *Sailor Saturn*. *Sailor Saturn* owns weapon of outer solar system, a silence glaive. As born and ruled by astrological sign of Capricorn, *Sailor Saturn* has the personality of ambitious, determined, materialistic, strong,

and extremely dedicated to a person she cares that makes her appear as isolated, timid, quiet, and always keeps to herself. The awaken of *Sailor Saturn* was scared those outer *Sailor Guardian* due to extremely powerful and can cause malicious destruction. Her strongest attacks are *Death Reborn Revolution*, *Silence Wall*, and *Silence Glaive Surprise*.



Figure 13. Character design for *Sailor Saturn* (left) and planet Saturn (right)

k) *Tuxedo Mask* represents the planet Earth

Tuxedo Mask is a male reborn as Momoru Chiba on August 3rd. He is the prince of home planet Earth. He uses his alter ego character of *Tuxedo Mask* to seek for his true identity after losing memory due to car accident, cause the death of his parent. He is being illustrates as a tall and charming guy. His attractive feature always gets a lot of attention from most girls and among *Sailor Guardians* (Figure 14). However, he has a deep feeling and connection with *Sailor Moon*. He is always her supporter alongside fighting with her. As born and ruled by astrological sign of Leo, he is portrayed as loyal, lively, and honest. That makes him enjoy having a mysterious persona being *Tuxedo Mask* and live *Sailor Moon* with high curiosity. He has been awakened and realised he was *Endymion*. Somewhere in Earth, there is a hidden place call *Elysion* that used to be a place for Golden Kingdom. *Endymion* was the ruler of the kingdom and protected by *Helios* (who cursed to be a *Pegasus*). He is also portrayed as the golden crystal of Golden Kingdom and use it along with other crystal of 10 *Sailor Guardians* as the source to level up *Sailor Moon* into *Eternal Sailor Moon*. In 30th century, he will be married to *Sailor Moon* and both become *Neo-Queen Serenity* and *King Endymion*, living in Crystal Palace. Due to power of Moon, they can live longer than normal human life without aging.



Figure 14. Character design for *Tuxedo Mask* (left) and planet Earth (right)

Potential STEM Learning Outcomes

The main educational value represented in this anime series is the STEM content about our planetary solar system. There is potential STEM learning outcome which can be retained from *Pretty Guardian Sailor Moon Crystal*. Beside enjoying the fictional storyline, children who watch this anime series will be able to learn about planetary solar system. As part of STEM education, the solar system is a topic in the curricular of science subject. Malaysian syllabus, the *Kurikulum Standard Sekolah Rendah* (KSSR) introduces children at the age

of 9 years old about solar system through *KSSR Sains Tahun 3 Sekolah Kebangsaan* textbook (Figure 15). In this topic, children will learn about the members of solar system, planet's temperature, orbit, and the time taken of each planet to complete the circle.

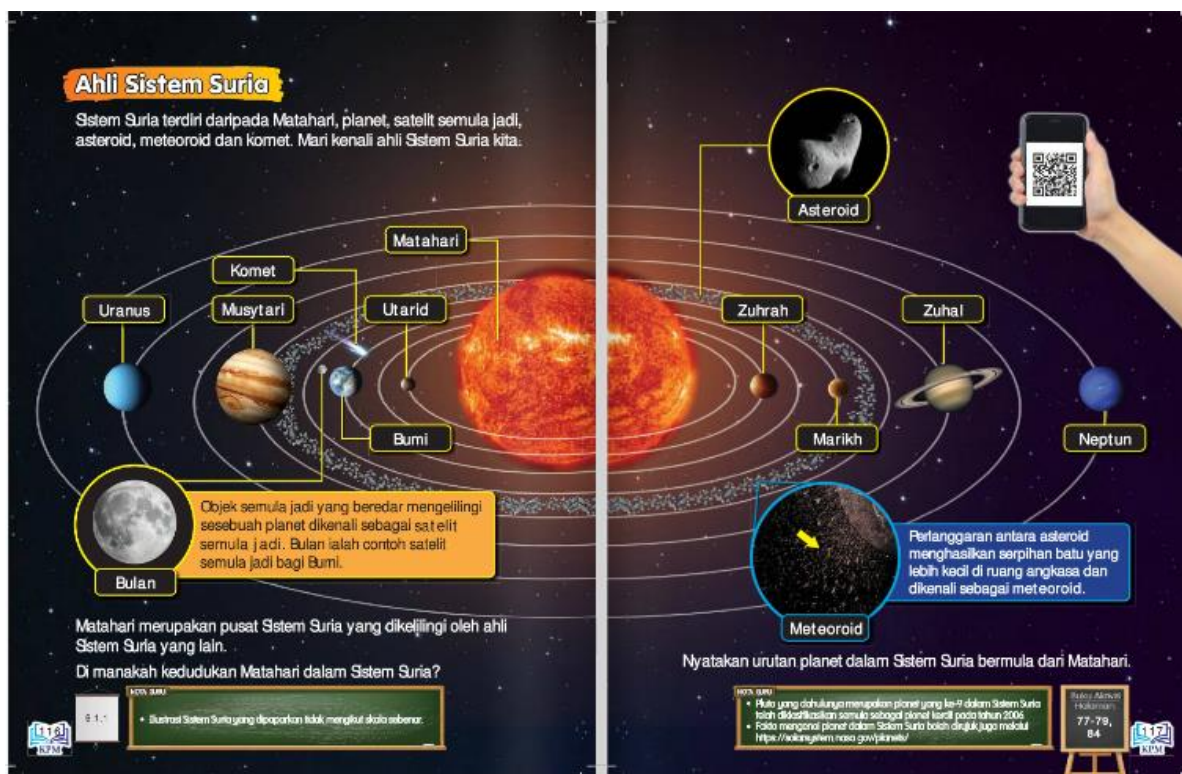


Figure 15. Topic solar system in Malaysian STEM education through *Sains KSSR Tahun 3*.

This prior knowledge exposed to children will help them recap and relate to the *Sailor Guardians*. By watching *Pretty Guardian Sailor Moon Crystal*, they might be able to remember and named all the 9 planetary solar system. Other than that, Moon is the natural satellite of each planet. By relating into the story, each *Sailor Guardian* must protect and be closer towards *Sailor Moon*. The love between *Sailor Moon* as Princess of the Moon and Tuxedo Mask as Princess of the Earth symbolises the relationship between Moon and Earth. Moon gives impact to the Earth in term of life which are time, tides and light (Lotzof, 2022). If there is no moon, the high and low tides would estimate to shrinks by 75% (Kim & Orwig, 2021). Moon and Earth are needed towards each other. Hence, the main STEM learning concept that children might recall while watching this anime series are 1) the name of each planet in solar system and 2) Moon is the natural satellite own by each planet and the values of love where one can be contradictory to the one he/she loves yet supplement the need of each other with the understanding; that every one has a positive and negative element, but loving each other helps sought things out to understand each other, give what others need, and help others to improve themselves so every body can live in peace.

THE WAY FOWARD AND FUTURE PERSPECTIVE

Based on the interpretation of extracted qualitative data, *Pretty Guardian Sailor Moon Crystal* anime series can be classified as STEM-based anime. Children who are watching the series indirectly can relate into their pre-existing knowledge about the planetary solar system. Perhaps, they may remember the name of each member of the planetary solar system correctly. There are indicators comprise towards the classification mainly STEM content; fictional visual representation of STEM content; and potential STEM learning outcome. These three basic indicators are useful enough as conceptual representation to classify and examine the STEM-based anime. For futures perspective, this conceptual model generated by this study can be applied

into any anime whether the anime is suitable as STEM-based anime. Hence, the indicator could be operationalized to measure the classification empirically.

CONCLUSION

As a conclusion, *Sailor Moon* is a popular anime TV series that provide learning environment of STEM education. This educational value has been integrated into entertainment platform. This anime has been designed and developed based on STEM learning content, which is the concept of planetary solar system. Naoko Takeuchi who is the original writer and creator of *Sailor Moon* used the concept of astronomy and astrology along with the elements of fashion to aesthetically design each specific characters and the relation into the storyline. Result indicate that *Sailor Moon* owns the three main principal criteria which are STEM content (planetary solar system); fictional visual representation of STEM content (character design inspired by planetary solar system); and potential STEM learning outcome (the name of each planetary solar system). Based on the model obtained in this study, this *Pretty Guardian Sailor Moon Crystal* series suitable to be classified as STEM-based anime. The conceptual model of STEM-based anime can be applied into any anime to look at the potential classifications as STEM-based anime. It can serve as the guideline for teacher, animation producer, or writer to produce better anime that is inspired by STEM topic in future. Perhaps, the anime TV series can continue to provide better personalised learning for STEM education.

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