STEAM-ing: Preliminary Insights in Consolidating Arts with STEM

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Abstract: Science, mathematics, technology, and engineering (STEM) have long been acknowledged as subjects that are fundamental for national progress and growth. Efforts to integrate the "arts" component in the teaching and learning of STEM subjects have begun over two decades ago through the introduction of KBSR and KBSM in the Malaysian school curriculum; however, its implementation received mixed reactions. The reason is that although "art" can and does make STEM subjects interesting and engaging, it could also distract and remove the focus away from STEM components. Realizing the importance of Arts in complementing the learning of science-based subjects in terms of creativity and collaborative focus, this study aims to uncover the views schoolteachers encounter as they try to integrate Arts in STEM teaching. Using a qualitative approach, the study involved teachers currently teaching STEM subjects in local public and private schools. Data was collected via a semi-structured interview with four experienced Science teachers. Findings revealed all Science teachers unanimously agree the integration of Visual Arts elements in STEM could ease various pedagogical challenges which include students' thinking ability, practical knowledge, and ability in technology; constraints related to teaching aid and ensuring student understanding of "difficult" topics in the lower secondary Science syllabus.

Keywords: STEM Education, Visual Art

1. Introduction

Nur Nabihah Mohd Nizar, Mohd Khairezan Rahmat, Siti Zuraida Maaruf, and Siti Maftuhah Damio (2019) have highlighted that the advance of digital technology has now made major changes to the world. The birth of varieties of digital technology has also developed and evolved. In fostering Malaysians to be scientifically and technologically progressive, the Malaysian Education Ministry has emphasized the advantages and importance of learning all subjects in an integrated manner. Mohd Khairul Azlan Bin Rahmat and Siti Zuraida Maaruf (2017) also agreed that with new technologies, the process of learning can be simplified or enhanced which could eventually increase the quality of the art subject taught. This was evident through the introduction of primary and secondary school integrated curriculum known as *Kurikulum Bersepadu Sekolah Rendah* (KBSR) for the primary level and

Kurikulum Bersepadu Sekolah Menengah, (KBSM) for the secondary level in 1993. The integrated curriculum is aimed to encourage learning that is authentic in content and process whilst promoting rich, personalized experiences as the learners make connections with the topic or concept. Presently, Malaysian school curriculum still retains the notion of integration across subject matter albeit the emphasis has since shifted to a standard-based one. It was recently revealed that the existing proportion of science stream students' enrolment stood at only 19 percent out of about 447,000 PT3 candidates when they enrolled for the Form Four level (Faizatul, 2020)

Despite having in place an integrated curriculum, learning, and teaching in Malaysian schools remain largely fragmented by subjects. There is also an over-emphasis on the need to deliver curriculum content within a stipulated timeline, and the expectations for students achieving not just any good grades but those with distinctions (Nurul-Awanis, Hazlina, Yoke-May, &. Zariyawati, 2011). These, in turn, have forced learning and teaching to be didactic and mechanical at the expense of the values underlying intentions of incorporating different areas within the curriculum, like infusing language and art in the learning of science for more wholesome learning. It was also previously identified that the paucity of learning-by-doing, possibly due to inferior teacher pedagogical and technology-related know-how, has raised concerns from various stakeholders on students' mastery in problem-solving, computational thinking, and critical thinking (Ahmad Zamri, 2017). In essence, since much of what transpired in the classroom is dependent on the teachers' knowledge, teaching efficacy, contextual circumstances as well as the choice of instructional approach, there are cogent reasons to examine the views and challenges teachers encounter as they strive to work on ensuring that the teaching of STEM occurs in an integrated manner with other subjects.

2. Research Background

It was mentioned by former Education Minister, YB Dr. Maszlee Malik that there is an average decline of six thousand STEM students yearly from 2012 to 2018 in his main speech at Bett Asia Leadership Summit and Expo 2019 (Salhani, 2019). Compilation of various data and studies by the Ministry of Education (MOE) (2013) indicates there are four contributing issues affecting the decline of students in the Science stream, the first being ineffectual curriculum. In the Malaysia Education Blueprint 2013-2025, it was reported that the existing STEM curriculum is ladened with facts and information instead of knowledge application; hence did not adequately emphasize the significance of concepts in everyday life. Students cannot see the STEM's usefulness and worth to them.

The second factor leading to dwindling student numbers in STEM is related to the students' views and choice of career pathways. Nor Samsinar Kamsi et al. (2019) in their research revealed that the undergraduates believe the demand for STEM workers might be stiff due to very high expectations. Delving into the STEM field is also seen as more difficult, with a higher tendency of not performing and even dropping out of university. To add to this downbeat assessment of STEM, students' choice of academic programs and career pathways are also likely based on inadequate information on STEM professions (Lilia et al., 2019), echoing Holman and Finegold's (2010) claim that students' unfavorable views of STEM are largely the result of poor understanding of skills, job prospects and qualification related to STEM. Therefore, the students may not be attracted to STEM professions (Wyss, Heulskamp & Siebert, 2012).

Next, lack of awareness on the importance of science and technology for the real-world situation was also cited as a reason for not wanting to venture into STEM. Despite efforts to promote STEM via the offering of different learning packages by MOE, persistent reports are suggesting that students at all levels remained not quite aware of STEM subjects and having trouble understanding various topics with STEM subjects (Ismail, et al., 2019; Maruthai, 2019). This issue could also stem from the teachers' knowledge and pedagogical know-how since they are the ones largely responsible for introducing, deliberating, and showing how knowledge of science and technology is central to the survival of mankind.

The final cause for students not wanting to do science put forth by MOE is the quality of teaching and learning. Saat et al. (2021) reported the teacher respondents in their study confessed to not having the latest scientific skills in conducting experiments and that they conducted experiments based on the recent textbooks. Meanwhile, the scientists involved in the same project agreed that the teachers lacked confidence due to a deficiency of training. This is congruent with Mohamed Nor et al.'s (2018)

claim that many teachers not only lack creativity and the ability to innovate in Science but are also limited in their know-how to perform experiments and other hands-on activities; all of which could be due to training shortcomings. The notion a majority of science educators are still struggling to comprehend STEM concepts and to make links across the STEM disciplines have been reported in numerous studies (Siew et al., 2015, Ramli & Talib, 2017, Mahmud et al., 2018; and Fadzil et al,2019) Thomas & Watters (2015) mentioned, in Malaysia, other than the issue of teachers' competency, the teaching and learning quality in STEM classes are also hampered by large class sizes (of 40 to 50 pupils per class) and poorly equipped classrooms. Nur Hidayahtuljamilah Ramli et al. (2013), Adlina et al. (2014) Mei et al. (2017) and Nalini et al. (2019) also agreed and highlighted the similar issue in their research. Joseph (2018) agreed that the absence of knowledgeable and skilled teachers as well as science facilities and resources would disrupt the quality of STEM subjects.

The roles that teachers play in addressing STEM education issues are evident. Teachers must teach with clarity, enthusiasm, and passion for students to achieve not only sound understanding but also enough interest and passion to pursue STEM as their choice of career pathway. Vygotsky's Social Constructivist theory which serves as the underpinning theory of this research is deemed apt given teachers' facilitative function that allows for cognitive as well as behavioral changes in and out of class. One effort to assist learning includes using appropriate resources, media, and other forms of teaching aid to enhance instruction (Hamid, 2014).

Numerous studies have drawn attention to the inclusion of appropriate Arts elements to enhance and improve teaching and learning, including that of science. Bequtte and Bequette (2012) have earlier shown that solving scientific problems may be carried out via the use of various prolific artistic mediums which include representation of concepts or objects through creative processes and design thinking. In a similar vein, Colucci-Cray et al. (2017) claim the inclusion of creative approaches does support conceptual thinking in science education through STEAM; Art and its creative processes may allow students to explore and unlock multiple intelligences. Nonetheless, educationists agree with the need for more practice-based shreds of evidence and literature for the sound claim that art-based activities and creativity do enhance science education.

Essentially, since the teachers are the front-liners of education, their feedbacks are valuable in determining the effectiveness of the educational system from their teaching practices. Their insights can be used as the needs analysis in continuous efforts to improve the state of the educational practices in Science, Technology, Engineering, Arts, and Mathematics (STEAM). The findings subsequently reported is a sub-section of a bigger study whereby the researchers embark on efforts to make science learning more exciting and meaningful for students via the embedment of visual art elements in science.

2.1 Objectives of Research

Based on the concerns highlighted, this study was carried out with the following objectives:

1. to identify the challenges faced by science teachers in teaching the subject,
2. to investigate the teachers' view on existing science module(s) and the need for integration of visual art elements into the module, and
3. to explore the teachers' opinion on the visual art elements that can be integrated into the module.

3. Methodology

A qualitative approach employing semi-structured interviews served as the primary means of data collection. Four science teachers teaching lower secondary level were purposively chosen as research participants. All teachers have taught science for more than five years; hence deemed fitting the researchers' criteria for respondents. Other than being able to provide relevant information on the needs and challenges of teaching science, the teachers too had ample experiences to share their views on how art-related elements could be infused in science learning and teaching. Selection of teacher also took into consideration fair representation of expertise within the science field; hence there was one teacher each who majored in Biology (Teacher 1) and Physics (Teacher 4) and the remaining two (Teachers 2 and 3) specializes in Chemistry. All teachers were interviewed individually to allow for detailed probing and to avoid them from influencing each other when responding to the interview questions.

The data gathering process began with the researchers developing an interview protocol which was then checked by two experts, each in the fields of teacher education and science education. Upon ensuring the face validity of the instrument, one of the researchers then initiated contact with the respondents via telephone to briefly explain the research. An email containing relevant documents which include informed consent and research overview was sent for documentation and formality to individual teacher participants who agreed to become research participants. Since it was in the movement control order (MCO) period by the government because of the covid-19 pandemic, the interviews were done via google meet and WhatsApp video calls. Before the interview session, the researcher took time to explain once again the purpose, objectives, and significance of the research to the participants. The participants were also informed that the interview session will be recorded, and all responses are confidential and will be used for academic purposes only. The interviews took between one to one and half hours each. Recordings of the interviews were later transcribed, and data were analyzed verbatim using MS software. To establish the credibility and trustworthiness of the findings, member checking was employed whereby the teacher participants were asked to verify both the interview transcripts and the outcome of the analysis.

4. Results and Discussion

4.1 Challenges faced by the lower secondary Science teachers in teaching Science.

Four themes emerged on the challenges faced by the teachers, namely (a) students' thinking ability, (b) students' practical knowledge and ability in technology, (c) constraints related to teaching aid, and (d) teaching "difficult" topics in the lower secondary Science syllabus.

a. Students' thinking ability

One aspect which was repeatedly mentioned throughout the interviews deals with students' thinking ability. Thinking ability here may include the students' ability to understand science concepts and ideas, their reasoning capability as well as the thought processes they engage in which may, in turn, influence their propensity to solve problems. Among the concerns related to thinking ability voiced by the teacher participants are as follows:

> *Pupils have different levels of understanding according to their abilities. They have different learning skills. It is difficult for us to cater one by one (Teacher 1)*

> *Sometimes, students at various levels do not see what the teacher is trying to convey. So before giving an assignment or relating a topic to hands-on activities, teachers need to be a source of ideas for students. Otherwise, students do not understand what they are going to learn (Teacher 2)*

Teaching groups of students who are of comparable intellect are already challenging enough due to variations in motivation, learning preferences, and personality, just to name a few. With students no longer grouped by ability and/or aptitude resulting from the abolishment of the streaming system in Malaysia classrooms, schoolteachers struggle with the task of having to teach effectively while having to address student variations as indicated in the following excerpts:

> *So, we as teachers need to understand their ….passions…way of thinking…how they learn and help them to understand the subject of Science which may not be a subject they like or want to learn (Teacher 1)*

> *…..it is difficult for teachers to prepare activities for various levels and stages. Furthermore, teaching and learning time is limited. (Teacher 3)*

> *The challenge I faced is to attract students of various levels to study Science. For some students, Science is difficult to understand. (Teacher 4)*

This situation happened when the standardized public examination at Year Six (known as *Ujian Penilaian Sekolah Rendah* or UPSR), and the standardized public assessment in Form Three (*Pentaksiran Tingkatan 3* or PT3) ceased in 2019 and 2020, respectively. Without these examinations, no mechanism has been put in place to group students by ability in most schools.

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b. Students' practical knowledge and ability in technology

With technological advancement and the availability of the internet becoming easy and widespread, school students are becoming conversant with the use of the internet in daily activities including its advantages in education. Now that gadgets are made affordably, almost every household would at least have android technology mobile phones. This has consequently affected classroom learning because students are familiar with the process of searching for information using mobile technology. It makes classroom teaching challenging for teachers, especially so if the students appear to know more about what is being taught, as highlighted by the following respondents:

> *Students of the current generation get bored quickly, maybe one of the factors is that they are more advanced and have learned the contents of learning by doing their search on the internet (Teacher 3)*
>
> *Pupils are also exposed to IT advances. They knew the internet since birth, all at their fingertips. Students nowadays are more advanced, they love visuals, videos, and IT elements. Teachers need to provide interesting teaching aid to help students understand the content of the lessons (Teacher 4)*

If the teachers overlook this aspect, it would be embarrassing for them.

Thence, teachers must equip themselves with cutting-edge technological knowledge and skills. And to do so requires sound infrastructure and infostructure in schools. Nonetheless, currently, there is a gap between what teachers would ideally want – the presence of technologically equipped classrooms including good internet connection – and the facilities that are present, resulting in the low implementation of technologies as well as lack of teacher motivation to use technology in teaching and learning (Mohd Kamal, Adnan, Azamri, Idris, Zuraimi & M. Yusof, 2019). Ahmad et al. (2019) claim that the teachers at all levels are finding it difficult to sustain prolific teaching and learning in their classrooms if there are no actions taken to bond the breach between the socially and technologically skillful millennials and the decaying traditional method of teaching and learning, akin to the feelings expressed by the following respondents:

> *So, all this IT knowledge needs to be integrated into the classroom, to attract interest and to increase the students' understanding (Teacher1)*
>
> *Secondly, the teacher needs to be more prepared for teaching and learning sessions and more advanced than the students because students can access the internet and maybe more advanced than teachers. Teachers need to know and be willing to teach Science with the knowledge contained in textbooks and more than that (textbooks) (Teacher 2)*

c. Constrains related to teaching aid

Two teacher participants drew the researchers' attention to the difficulties in preparing useful and interesting teaching aids to supplement teaching and learning. Teachers' knowledge and creativity, as well as time constraint, are often-cited limiting factors for teachers to prepare good quality learning materials such as PowerPoint slides, interactive simulations, and models (Fazura, 2011; Arzizul & Dg, 2018). To top the teachers' frustrations, lack of apparatus and materials to carry out experiments also often result in students being short-changed of authentic learning experiences as pointed out by the following participants:

> *In my experience, material and experimental apparatus constraints make it difficult for students to conduct experiments because one group consists of 4-6 people. So, it is difficult for all students to gain experience conducting experiments. There are some experiments where only the teachers make demos or show videos only due to these constraints (Teacher 3)*

> *Teachers need to provide interesting teaching aids to help students understand the content of the lessons. But with the time constraints, I did not have time to prepare teaching aids. The existing aids are not up to date with the new syllabus, even if there are, they are from overseas, sometimes their terms and slang are difficult for students to understand. (Teacher 4)*

For students to comprehend science concepts well, especially abstract ones such as gravity, mole, and current, it is imperative that good, interactive teaching aid and other learning materials are used. And often, given the multitude of teacher academic and non-academic tasks, time is a major factor that pulls back teachers from creating their supplementary teaching aids.

d. Most difficult topics the lower secondary Science syllabus

The teacher participants also shared that certain science topics have barriers that make teaching and learning challenges. Several topics in the syllabus were mentioned but all participants identified the Energy and Sustainability of Life theme as most challenging, with Electricity and Magnetism being specifically alluded to:

> *The topic that I think is quite difficult for the students to understand referring to the final year examination analysis items are in chapter seven Electricity and Magnetic, and chapter eight, Force and Motion. There are students who get zero, zero over four, one over four etc. I think the pupils are having problem in this topic (Teacher 1)*

> *…overall for Science, it is divided into several themes, so from my opinion, themes that relate to Electricity is more to Physics subject, the topic is more difficult compared to other topics (Teacher 2)*

> *It is Chapter Seven, Electricity and Magnetism. Okay, if it is taken from sub-topics, I think (Teacher 3)*

> *One topic Waves, Sound Waves, the other one is Electricity, and another one is Motion, Force and Motion. (Teacher 4)*

These topics require students to have good conceptual thinking skills because the content involves non-concrete concepts and many teachers including the following respondents struggled explaining abstracts:

> *It is quite difficult for me to teach because to give understanding to students it is easier if it can be associated with using the senses. Something that exists. But the titles Electricity and Magnetism and Force and Motion cannot be shown through the naked eye. I need teaching aids like iron powder or an illustration in teaching this chapter. Like I said earlier, if I teach topic that based on Bio(logy) or Chemistry, students are easy to understand because they can feel, see with their eyes and tongue, their senses. But if the title is based on Physics, the teacher needs to be more creative to help students understand what the teacher is trying to convey (Teacher 1)*

> *Okay… electromagnet is related to the electric current that has a magnetic effect. So, in the electricity there are current, we do not see the current. We can only see that when we connect to an electronic device such as a lamp, the lamp will turn on. So, in terms of the movement of the current and the shape of the magnetic field, students confuse the direction*

> *of the magnetic field, the direction of the current. They are confused if the teacher explains verbally that they do not see. So, they need the help of ABM (teaching aids) oh there is a current flowing, there is a magnetic field (Teacher 3)*

In this case, teachers' ability to illustrate abstract concepts for explanation is highly useful. Nevertheless, Turkka, Haatainen, and Aksela (2017) explained that the ability to draw certain concepts may not be the forte of some teachers especially when the content requires certain fine drawing skills such as the anatomies, but it would not be difficult for them to create graphs or molecules and equations. Saroja, Ravi, and Jamilah (2014) opined that through the integration of visual art, all learners can easily understand science concepts and processes. Here, the content teachers can collaborate with the art teachers to share thoughts and skills in both areas. This notion of art teachers working across the curriculum together with content-area teachers have been proposed a decade earlier by Ohler (2000).

Another reason why teachers find certain topics challenging to teach has to do with the absence of appropriate apparatuses and/or facilities to perform experiments. Experiments do not only allow the demonstration of abstract concepts (evaporation, gravity, motion, etc.) and processes (such as reactions) but also aid in the acquisition of science process skills like classifying, measuring, predicting, and communicating. Additionally, students would lose interest when the teachers only discussed scientific theories without any experimental demonstration. Collins, (2013) mentioned that science and art are two topics that balance each other (as) art activities turn science concepts that may or may not work in an experiment into something visual and hands-on.

Another aspect being put forward by the teacher participants when teaching difficult topics is the importance of ensuring that students possess sound prior knowledge of concepts being taught. The development of school curriculum in most countries follows Tyler's (1952) principles of continuity, sequencing, and integration. In the Malaysian context, for students to do well in upper secondary science subjects like Physics, Chemistry, and Biology, they need to have a good understanding of the same concepts introduced in a general science subject at a lower secondary level well. If their prior knowledge on a topic is mediocre or weak, reviewing the past syllabus becomes inevitable as suggested in the following excerpts:

> *The Electricity topic in this form has something to do with Electricity topic in form three later. So, the basics are here. If they are not very efficient here, not very clear in form two, when it comes to form three, the teacher must start back from zero. So, the teacher had to struggle to take more time to refresh the students' existing knowledge. Simple calculations, in Form 3 they will learn more details (Teacher 2)*

> *This title continues with the upper secondary Physics. If you look at the title earlier, it is mostly about Physics. So, in Physics, there will be Wave topic again for form five but about another Wave. Same goes to Electric and Force. The level is higher. Now Form Two, they must learn the basic first. The other reason is, we want to provide as many Science students as possible for upper secondary level later (Teacher 4)*

One approach to ensure students understand science concepts well is by emphasizing learning science through real-life exemplars, getting them to solve authentic problems and working collaboratively, preferably using the 5E (engage, explore, explain, elaborate and evaluate) method of the inquiry-based approach (Seroja, Ravi & Jamilah, 2014). It is also suggested that teachers relate complex science concepts and facts with visual illustrations to ease understanding (Dickinson, 2005). Visual illustrations also tend to capture students' attention, long enough to commit the information in their long-term memory.

> *Students have learned this topic of electricity in sixth grade in primary school (Primary Six). When it is introduced again, they take it easy and are not prepared. So, for example like electricity, this topic is normal for them. So, theory of electricity is included in the secondary syllabus. When it comes to the theory section, it is quite boring for students who may have visual learning style. So, they need to be helped with other supporting tools*

such as experiments or visual-based teaching aids that will help attract the students' interest to deepen the topic (Teacher 2)

If we look at this topic, it is important in our daily lives. For example, later in the future in the house, the lights will turn off, they should know if the circuits are installed in series or in parallel and what kind of wiring is it. That is an example that this topic can be applied in their daily lives. That is why the topic is important for them. Science is about our daily lives. Apart from that, this topic has a connection in form three, and it is a broad topic. It is difficult for the students to understand if they only learn all in form three (Teacher 1)

4.2 Teachers' view on the existing Science Module and the need for integration of Visual Art elements

Three dominant themes emerged when the participants shared their opinion about available science modules in the market: module content, module variation, and module presentation.

All participants felt there is a need to revise existing content prior to printed modules being put on the shelves or made accessible to students. Most available modules still follow the old curriculum, rendering them obsolete as suggested by the following participant:

… for now, it is quite limited to find the book that refer to [the current curriculum] KSSM (Kurikulum Standard Sekolah Menengah – Secondary School Curriculum Standards) based on DSKP…. nothing that can be said to be good because there are not many options[since]… many in the form of old formats, old syllabus (Teacher 3)

Aside from content which may no longer be relevant, available modules are also limited in terms of variation. Although there are efforts to offer modules in varying forms – digital or otherwise – the ones available are limited. There are also other accompanying issues related to module variation, such as the one mentioned by Teacher 2 below:

They're very limited in term of variety. …. There is a science comic book which I think is very interesting, but I am worried that the content does not fit the Science syllabus. In my opinion, the author of the book or comic needs to have knowledge so that the information and concepts of science can be learned by students even in any medium for example PowerPoint and animation. We do not want students to just have fun but after finishing class, students cannot achieve the objectives that we set (Teacher 2)

Meanwhile, there may be some good modules, but they are in languages other than the national language:

Materials for Science in Malay are very limited. Mostly are from overseas. Mostly, the Science animated videos are from the UK or US using English language. If there are in Malay, it is in Indonesian language. It is hard to get Malay version otherwise, the teacher must make a new one or edit the existing videos (Teacher 4)

In softcopy, for example the Science materials on the Internet, most of them are from Indonesia. There is no material of sorts from Malaysia. Like the solar system, we show the materials to the students because we are trying to explain the unexplainable. So, we must show the solar system animation. But when I click the links, most of them are from Indonesia. So, when the language is different, the students have difficulties understanding. They sometimes make jokes that they could not understand the language (Teacher 1)

In cases like the above, teachers may end up with the additional task of having to translate the content and in the process making certain that the meaning is retained. Alternatively, using the modules in their original form may pose confusion if students are not quite proficient in the language.

On a positive note, the teacher participants did voice their approval over the physical presence of existing modules. Apart from colouring pages, most modules also used graphic organizers like mind or concept maps, diagrams and other forms of infographics.

> *I see that the science book has mind maps with colours and interesting. The trend now is with colour. There are no problems with those hard copies (Teacher 1)*

> *There are books that included Infographics. It usually in reference books. At the beginning of the reference books, they use it as a summary of the topic. There has not been any totally Infographic. The teachers must be selective in choosing the books to ensure that students get accurate information, in addition it must be in a form that is more friendly. The students like to learn in this form which is simple. It is easier for them to understand (Teacher 2)*

The responses suggest that all unanimously agreed on the need to integrate Arts element into the Science module. They believe that such move could stimulate student interest in the topics, leading toward clarity of content and better understanding of concepts. In other words, through the inclusion of artistic elements, it is hoped that students would find Science attractive and be more focussed during classroom sessions as indicated by Teacher 2 below:

> *Through my observations, textbooks are now more colourful in each page and attract students' attention compared to old syllabus books. These colourful elements attract students to read, understand and so on. Indeed, the integration of visual arts elements in Science education modules is very welcome (Teacher 2)*

As previously suggested, this would ultimately provide more authentic and engaging learning experience, while meeting contemporary students' educational needs (Turkka, Haatainen, & Aksela, 2017; Braund & Reiss, 2019; Corrienna , et al., 2019). It is worthy to caution that teachers would need some training in the Visual Arts to enable them to develop and enhance their basic artistic skills using ready to use diagrams are usually available as teaching aids.

It was also brought to the researchers' attention that the teachers find the textbook presentation is more interesting with the integration of Visual Arts elements. These statements supported by (Abdul Rahman, Alias, Siraj & Hussin, 2013) mentioned that the use of graphic materials in the form 2D or 3D adds stimulus to the page on each subject. It should be highlighted in applying creativity and innovation in textbooks.

> *The integration of Visual Art elements into the Science Module is … necessary because in Science, there are many diagrams and labels that students need to understand and mast Visual Arts can help students recall topics, diagrams, and labels in a more relaxed form by drawing comics, infographics, flow charts and so on…Through this integration, students are quicker to remember because the material or activity has combined the left and right brain. This makes their thinking more divided, but it needs to be guided to be in line with the objectives of the Science subject (Teacher 1)*

> *It is very necessary because when there is an element of visual art, students will quickly understand guided by beautiful and interesting illustrations. But most importantly, the element must harmonize with the subject of Science itself. Many things in Science subjects are difficult for students to imagine. Therefore, students need the help of Visual Art elements (Teacher 3)*

> *The integration of visual arts is felt to be very useful and can attract students when they get a clearer and more detailed picture of the pictures produced through visual art. The picture can also increase the students' understanding of things that are not visible to the naked eye (Teacher 4)*

4.3 Teachers' opinion on the Visual Art elements that need to be integration into the module.

When asked specific Visual Art content that can be included to improve science module, all teachers called attention to the use of images to assist and improve learning of scientific content, especially for conceptual understanding of scientific theories such as electric current and sound wave. Importantly, colourful presentation included in printed references is helpful in learning and memorization.

> *By using images, as I said before about waves, we cannot see waves, so that we cannot draw waves. So, with images with arrows showing the waves' directions with multiples ways to remember or remembering technique. There is a tip how to remember the magnet field by using our right hand. So, the students can use the concept to know the directions of the magnetic field, but with interesting visuals, it will easier the students to study using those tips. Even though by making experiments, the waves still cannot be seen but with the help of images the students can see the direction of the waves and the direction of magnetic field (Teacher 3)*

> *Images are important in Science. But we have to identify the suitable images and right to the science concept for example if the illustrator draws a burning fire, in science the fire is not only in orange colour, it also can be in green colour or blue colour that given a different meaning. The illustrator must be more sensitive about it and seek for the science experts' opinion, so that there will be no misconception. That is important (Teacher 2)*

> *If we look to the students' revision books, they like to choose book that have comic elements…they like those kinds of things. If the module has visual art elements, it will attract their attention (Teacher 4)*

Fauziah (2018) suggested educators apply infographics in making teaching aids because of the infographics' criteria that can resolve and visualize complex contents and information

The teachers also highlighted their preference of using the PowerPoint presentation to ease editing of teaching and learning content to make it suitable for students with different learning skills and levels.

> *PowerPoint slides are also helpful…I think a good PowerPoint do not have a lot of words. Because the teacher will explain, and the students will read back. Let them look at the picture and let us explain. I mean, show only keywords in the slide. No need to be long. If there are too many words in the slides, the students did not want to read either…they only want to see what is next, see whether there is a picture. That is what they want and like (Teacher 1)*

> *I also used PowerPoint. In PowerPoint, if the information level is too high, we can tone it down, edit it into easy-to-understand language. So, if the PowerPoint is editable, it did not disturb the ongoing class. The PowerPoint are user friendly; we can edit to reducing student's confusion (Teacher 2)*

This statement refers to the standalone tools which can be edited and do not require an internet connection. According to Abdul Rahman et al. (2020), standalone tools are a group of teaching aids that are not carried by or need an internet connection, but must be installed, loaded, copied, and used on users' personal computers or workstations. For example, Microsoft PowerPoint is a presentation software used in past reviewed articles and is usually done with standalone systems

Essentially, the teachers emphasized that the Science module should be vetted and approved by science experts to ensure that the integration of Visual Arts elements is accurate to the intended scientific content. Accordingly, the inclusion of some animated element would make any form of digital presentation more engaging while the use of comic presentation in printed references have also gained the interest from students as suggested by the following participants:

> *Depends on the topic. If Biodiversity, the students prefer realistic images. But for topics like galaxy, the material is hard to find, so the animation will be suitable for that topic (Teacher 1)*
>
> *I think comic, infographic, animation really helps the students because they like in fun and easy source. We have a lot of graphics that link to a detail's infographic using the QR code and many more. The students already can used it and it really helps for those who an audio and visual type of learning. Maybe if we integrate it with art…illustrated by someone who know art and science, the content will become more lovely and attract students' interest (Teacher 2)*

The multimedia parts of visual art are the best solution, where the combination of more than one media type such as text, pictures, symbols, images, videos, audios, and animations usually with the aid of technology for the determination of helping memorization or understanding (Guan et al., 2018).

5 Conclusion

Nor Haniza bt Abdul Hamid, Nurzatulshima Kamarudin (2021) indicated that the thinking skills of students are the second aspiration, whereby cognitive skills, including the creativity element, should be encouraged among students. Therefore, creativity advancement among students is one of the most important elements in global education, including in Malaysia. It is evident that the Science teachers are unanimously in agreement with the integration of Visual Arts elements in STEM. The teachers also highlighted that some topics included in the syllabus require improved and enhanced teaching and learning aids, especially regarding scientific areas that require a good understanding of conceptual ideas such as in the topics Energy and Sustainability of Life, and Electric Magnetism. Importantly, the teachers emphasized the need to have Science experts review the content in the Science syllabus with its teaching aids to ensure quality learning while meeting the needs of contemporary advances. It is necessary to ensure the standards of the Science syllabus are up-to-date to contemporary STEM advances in the real-world setting (Colucci-Cray, et al., 2017). The teachers have also highlighted pertinent suggestions and opinions of the present classroom situation in which there is a need to improve the teaching aids for Science provided in schools. They have repeatedly brought up this concerning matter in their responses and emphasized the difficulties that teachers and students encounter when scientific concepts are hard to understand without relevant experimental demonstration and the scarcity or absence of necessary tools and material. Hence, more efforts towards the development of STEAM references should be given some rigour. Importantly, it had also been highlighted on the need to increase more research in STEAM to add more substantiated literature for future improvement especially in the Malaysian context (Ahmad Zamri, 2017; Mohamed Nor, et al., 2018; Corrienna , et al., 2019; Corrienna, Hassan, Rainer, & Marlina, 2019).

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