Malaysian Journal of Sustainable Environment
Vol.9.No.2 (2022) 195-214
doi: 10.24191/myse.v9i2.18834

THE DESIGN AND DEVELOPMENT OF STOP MOTION ANIMATION AS A PEDAGOGICAL TOOL FOR TEACHING AND LEARNING SCIENCE

Siti Zuraida Maaruf[1]*, Aini Mohd Nazri[2], Kaarthiyainy Supramaniam[3]& Akmal Ahamed Kamal[4]
***Corresponding author**
Faculty of Education, Universiti Teknologi MARA UiTM, Puncak Alam, Campus, 42300 Puncak Alam, Selangor, Malaysia
Sekolah Menengah Seksyen 17, 47500 Subang Jaya, Selangor, Malaysia

sitiz610@uitm.edu.my
g-50364490@moe-dl.edu.my
akmal@uitm.edu.my
Received:31 March 2022
Accepted:17 May 2022
Published: 31 August 2022

ABSTRACT

This study aims to develop a Stop Motion animation to help teachers enhance their teaching aids in Science and to identify the level of usability of the energy created. Problems in learning and teaching Science at secondary school arise when there are less attractive teaching aids and incompetent Science teachers. In this study, the non-experimental quantitative research design was applied to a sample of 30 Form One students from a secondary school in Shah Alam, Selangor, Malaysia. Pre-stage and post-stage questionnaires were used to get feedback on the usability of e-SMART as a teaching aid for learning Science. The teaching aid was developed based on ADDIE Model and multimedia elements in a selected topic from the Form One Science textbook. Almost all the respondents (97%) agreed that e-SMART helped them to learn Science better as they could focus, understand, and enjoy the lessons. All the respondents agreed that e-SMART should be used during science classes.

Keywords: *Stop Motion, Alternative Approach, Science Education,*

INTRODUCTION

Technology has been widely adopted to promote learners' understanding of content in the teaching of Science at all levels of education. Various technology-based methods had been utilized as effective pedagogical supporting materials (Siti Zuraida et al., 2019). An excellent example is the use of animation as part of teaching aids for Science which has come to be known as 'science animation'. It is a term used for animation designed to teach science concepts to learners. Generally, these include materials like presentation slide shows, pictures, and animated videos that could be used for general teaching, to 2-Dimensional and 3-Dimensional animation motion graphics and whiteboard animation for high accuracy content (see 6 Best Examples of Animated Science Videos in eLearning - F. Learning Studio (flearningstudio.com) for samples of animation used in education and training).

For teachers, these materials are a boon as they save teaching time and effort, and allow teachers to focus on content further. Likewise, students could learn difficult concepts more easily through the visuals complemented by the teacher's explanation as compared to verbalization. This is in line with Olayinka (2016) who adds that support materials are essential and relevant to be implemented in learning subjects, i.e. Science, as their uses can encourage teachers' efficiency and improve students' performance.

Although there are many types of animations that have been used for full education and training purposes, there are basic ones that could be used by educators to produce creative and versatile materials, e.g. cell animation, traditional animation, flip animation, flipbook animation, stop motion animation, and computer animation. While teachers could adopt many of the readily available ones on the Internet, for example, the link shared earlier, teachers could also delve into creating their own for a more personalized approach and style. Therefore we propose to stop motion animation as an option for teachers, especially those who are less tech-savvy, to experiment with.

Stop motion animation was created by Albert E. Smith and J. Stuart Blackton in 1898. It refers to a model or a puppet photographed in different poses on different frames. These frames are later compiled into software and turned into a video. Thus, the images would form movements. This type of animated filmmaking technique also allows characters to be manipulated as if they are moving independently (Mohd Zamani, 2012). Cut-out paper stop motion animation has become popular with young learners in the nineteenth century (Helen McCarthy, 1999). In other words, even teachers with basic photography skills could take individual frames of objects. When played back in a slow sequence, the photographed frames would appear in a sequenced motion. This technique does not require expensive tools as cut-out papers, clay, blackboards or whiteboards, objects, or human forms could be used.

Stop motion animation is considered rather 'new' in Malaysia as it is not well known as the animation industry in this country proliferated with the use of 2-Dimensional and 3-Dimensional animations. Stop motion animation is overshadowed by countless other techniques that produce more sophisticated products. However, there is room for stop motion animation in the classroom as it has its unique features and appeal in the Science classroom. Besides, it requires basic materials that are cost-effective (Md Abas, 2014) and could be created and used by teachers who are keen on expanding their repertoire of teaching techniques as compared to the run-of-the-mill aids that are commercially available. All it takes is a smart mobile phone to produce one.

Therefore the purpose of this study aims to demonstrate how teachers could use this stop motion animation for innovative teaching and learning process in schools specifically for Science education.

THE MALAYSIAN CONTEXT

In Malaysia, the education system is centralized, therefore the teaching of Science is regulated by the ministry. This means that the development of science teacher education parallels that of the development of the Malaysian education system. Lee (2004) and Mahmud et al. (2018) agree that Science teacher education in pre-independent Malaysia (Malaya) began in 1937,

which is two decades before independence in 1957. The then British government engaged graduate teachers from UK and India to teach at secondary schools. The British colonialists adopted the Scottish Integrated Science Syllabus for lower secondary school; the Nuffield Secondary School Science Curriculum and the Nuffield O- Level pure Science Syllabus for non-science and pure science streams at the upper secondary level from 1968 to 1981, in other words, the British syllabi which were continued even after independence.

However, in line with the national aspirations of nationhood, teacher training colleges and universities with science education were periodically increased from the 1980s (Lee 2004). This period of transition was an important one as the training providers also had to deal with materials development in preparing their trainees. In the era before the advent of the Internet and modern technology, this meant preparations that are 'manual intense' and tedious. This translates as repetitions of explanation and verbosity for a teacher with several classes.

When the medium of instruction was switched from English to Malay at primary and secondary schools in the mid-1980s, the drastic change placed many challenges on the Science teachers who not only had to focus on the content but also learn the technical jargon in the target language. It should be noted the teachers were previously trained in English but now had to switch to Malay. A flip of policy in 2003 saw teachers having to teach in English once again. With the older generation of Science teachers retired, the new generation had been solely trained in the national language. Later in 2016, 300 primary and secondary schools were selected for the Dual Language Programme which is to provide opportunities for students to use either English or Malay in Science and Mathematics. In the current Malaysia Education Blueprint 2013–2025 (MOE 2013), the MOE focuses on the delivery of quality STEM education through enhanced curriculum, testing, and training of science teachers, which is why it is important to equip science teachers with various technology-based tools to develop and strengthen their teaching repertoire irrespective of the languages used when teaching.

The onus is on teachers to be able to deliver content to the best of their abilities according to learner needs. While trained teachers have been

exposed to various instructional approaches and methods for materials development, untrained teachers in the content area, i.e. temporary teachers or nonscience options, need to quickly embrace appropriate pedagogical strategies for Science classes. Teaching a subject that they are not trained for is inappropriate. Worse, they have been found to erode teachers' confidence (Mizzi, 2013).

Furthermore, teachers may need to deal with the language of instructions which may not be in the language that they had been trained in, which could compound core problems (Mizzi, 2013; Seda, Gultan & Hulya, 2008; Keithellakpam, 2016) like completing the syllabus and preparing for high-stakes exams. Teachers' lived experiences in the classroom have direct implications on their students' learning and eventual academic performance, especially in a high-stakes exam context (Supramaniam, Nazer & Maaruf, 2020). In Malaysia, Science is a high-stake exam as only students who perform well in the subject move on to the science stream at higher secondary, and tertiary levels. Hence this study advocates the use of technology to lessen teachers' burden and entice students' interest in learning Science.

THE ADDIE MODEL AS A METHODOLOGICAL FRAMEWORK

This study applied the Analysis, Design, Develop, Implement, and Evaluate, or in short, the ADDIE Model which is an instructional systems design developmental process (Forrest, 2014). It is commonly used to design training programmes as the phases often lead to the best results. There are numerous visuals available for the ADDIE model but the one by Teh (2013) is reproduced below in Figure 1 here to further elaborate on the individual phases.

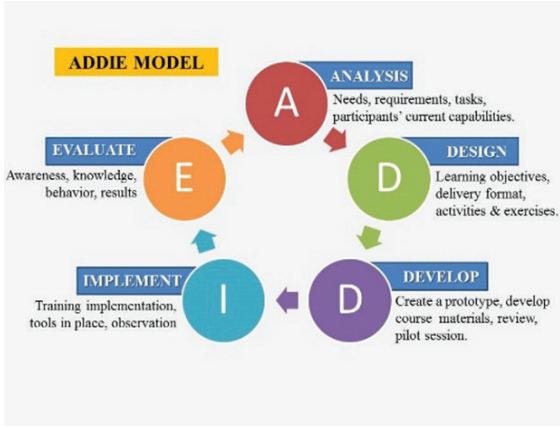


Figure 1. ADDIE Model chart (Ivan Teh, 2013)
Source: http://www.leadertipsforsuccess.com/attachments/Image/ADDIE.jpg

In the first phase of the model called 'Analyse', the researchers identify the problems in the context and the needs of the target participants. An important aspect of this phase is the training needs analysis in which the gap between the target and actual knowledge or skills of the participants are identified. This informs the researchers cum designers of the training programme on what to plan or focus on.

In this study, there was a need to discover how the stop motion animation that is considered rather 'new' in Malaysia could be utilized to teach students Science. A Form One topic entitled 'Cell as Basic Unit of Life' was randomly selected from the syllabus to demonstrate the possibilities of using the animation to complement teacher instructions. The teacher gave a questionnaire that surveyed the learners' prior experience of learning from animation in class, and their emotions towards the lessons as the teacher had to explain lessons verbally. As mentioned earlier, existing literature on Science teachers' challenges in teaching the subject is well documented, e.g. Lee, 2004; Mizzi, 2013; and Keithellakpam (2016), which suggests that not all teachers can articulate concepts well.

In the second phase, 'Design', the focus of the researchers lies on the learning objectives of the training programme, the format of delivery, activities, and exercises. The bulk of the data and discussion in this paper falls within the design and subsequent development phases as the researchers

planned the animation according to the content related to 'Cell as Basic Unit of Life'. The third phase 'Develop' draws on the information gathered in the earlier phases to produce a prototype for testing in the classroom. The fourth phase 'Implement' oversees training content, observations, implementation, and problems arising which in this case, transpire during the lessons. The last concluding phase called 'Evaluate' completes the cycle whereby evaluation or assessment is carried out to evaluate the value, quality, and other matters arising from the design. This was carried out mainly to discover the students' feedback on the animation.

RESEARCH METHODOLOGY

This qualitative descriptive study was designed to demonstrate the stop motion animation on the topic 'Cell as Basic Unit of Life'. Using the ADDIE framework, this study focused on the developmental phases to show how teachers could create the animation to cover the topic which is usually taught within 1-2 weeks as stipulated in the Form One Science syllabus. The researchers focused on a sample of an intact Form One class (n=30) at AM Secondary School, in the state of Selangor, Malaysia. Hence purposive sampling, also known as judgment (Etikan, Musa, & Alkassim, 2016) was applied as the class was under the purview of one of the researchers who were also their science teachers. The advantage of this dual role is that the science teacher was able to gauge the student's level of proficiency and learning skills during the teaching and learning process. In a non-intrusive way, the teacher was able to collect information through class activities to determine the students' needs, which according to the ADDIE model was the initial analysis phase. Besides, as a teacher herself, the teacher cum researcher was able to provide direct feedback on how the subsequent phases could be planned for the topic.

On the other hand, the students were from a special class called Kelas Rancangan Khas 1 (KRK 1) whereby students from this class were selected based on their primary Year Six results. Those who entered this special class must have scored at least three A's and two B's. The students who enrolled in the KRK 1 were considered more proficient in the language of instruction (Malay) due to the merit scores. This means that the researchers need not deal with low language proficiency as a variable that could disrupt

comprehension, and focus on the elements that were appropriate for the animation.

ELEMENTS OF MULTIMEDIA IN THE DEVELOPMENT OF THE STOP MOTION ANIMATION

This section discusses the elements of multimedia that were included in the design of the Stop motion animation prototype.

a.Text

According to Smith (2016), the text is the most traditional media in multimedia that is used to deliver information. Therefore the researchers opted for 'Annoying Kettle' (Kevin & Amanda, 2010), fonts that fitted the concept of chalkboard stop motion animation. The white fonts represented white chalks generally used on blackboard writing in a classroom. The fonts were fancy and were visible to the students.

Figure 2. Screenshot of a 'Scene'

Source: Author

The two screenshots in Figure 2 above depict the use of 'Annoying Kettle' fonts that reflect writing on the classroom blackboard. The figure on the left compares animal cells to plant cells. The figure on the right depicts a more casual statement that could be translated as "..the difference between us (i.e. the two cells) are vacuole, chloroplast and cell wall".

b.Images

As the teacher had adopted the concept of chalkboard stop motion animation, the images used in the animation were the original drawings

themselves. The characters and other supporting characters were drawn using natural chalk on a blackboard without additional photos. The images were considered a simple form of the characters that represented animal and plant cells. For teachers who are not very 'artistic', this approach demonstrates that they too could begin the animation using simple images.

c.Audio

Smith (2016) informs that audio plays an essential part in multimedia. The audio used in this stop motion animation was mainly a background song entitled 'I Like You' by Carly Rae Japsen in the piano version by LittleTranscriber (2015). The instrumental piano version of the original song was adopted to avoid distractions as there was no vocalization and created a relaxing mode.

d.Video

The stop motion animation was put together to produce a final product in the form of a video which was named 'e-SMART'. The duration is thirty-three seconds. The video was a compilation of photos captured according to frames. The materials such as text, audio, and images were combined and edited using a video maker software called Windows Movie Maker which was free for users.

e.Animation

Animation generally refers to an interactive method effect in which special features such as figures, buttons, and text are manipulated to produce movements. The main challenge is to encourage teachers who have not been trained in multimedia technology to adopt simple techniques as demonstrated below to produce an animation for science lessons.

STEPS FOR DEVELOPING THE STOP MOTION ANIMATION

There are generally ten steps involved in creating the Stop motion animation.

1.Thumbnail sketches

Firstly, thumbnail sketches were prepared. These sketches are a compilation of random drawings on a small scale and could be any object available from a surrounding. This is an early step to producing characters that were sketched in a sketchbook. Teachers who have limited resources could sketch on plain paper.

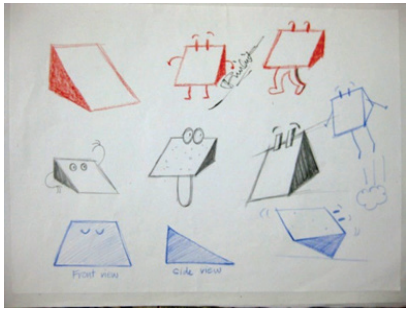


Figure 3. Thumbnail Sketches of Character Design

Source: Author

a.Idea development

The second step was the development of the idea in a sketch to deliver the message in the stop motion animation.

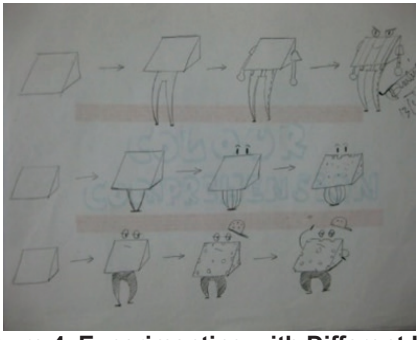


Figure 4. Experimenting with Different Images

Source: Author

The sketches took different forms to create a final appealing mascot as shown in Figure 4.

b.Colour comprehensive

The third step involved selecting appropriate colours for the Mascot as could be seen in Figure 5:

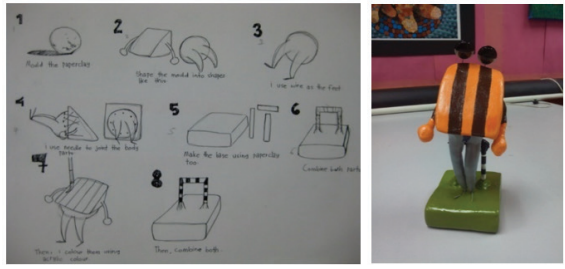
Figure 5. Experiments with Different colours on the Mascot

Source: Author

Many images of the same mascot were formed using colourful markers, pencil colours, magic colours, etc. The researchers deliberately used these simple colour tools to show that even teachers in a resource-challenged environment could carry out the tasks. Later, the best-coloured character was finalized for the following step.

c.Moulding the character into a model

The mascot had to be molded into a model for better reference. Paper clay was used because it was more accessible, cost-free, and lasted longer. The model should be able to stand on its own, so putting a stand beforehand was recommended. Then, the model was coloured using acrylic. There are cheaper options too like poster colour or any other colouring material opaque.



Figures 6. Sketches of the Molding Process and the Finished Mock-up Character

Source: Author

d.Constructing a storyline

The storyline is crucial as it depicts the flow of the video. It should be interesting to capture viewers' attention and interests, and for this study, the students were the primary viewers. Thus, a storyline should be appealing to the target audience.

e.Making a storyboard

The next step was making a storyboard. In this phase, the storyboard was made into several panels, and the story sequences were drawn inside each of the panels. At the bottom of each panel, a few notes like songs, sounds, or descriptions were written. It was essential to do so because it served as a reference point for the creator.

f.Setting up the place

This stop motion animation used a blackboard as the primary material, a blackboard, chalk, blackboard eraser, a camera with a tripod, and a place with good lighting were set up. The tripod was marked and taped to secure it. A place with good lighting was essential to avoid shadows in the photographs.

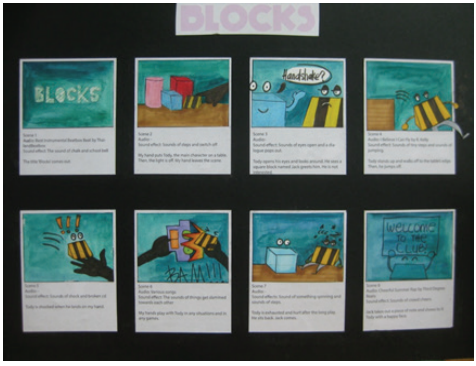


Figure 7.Storyboard for the Video

Source: Author

The storyboard created for the study as shown in Figure 7 depicts eight frames.

g.Photographing the images

The photography session begins with the capturing of images for the animation. A line was drawn and captured. Then, another line was removed, and it was captured. Figure 8 below shows the lines that were made in a logical flow:

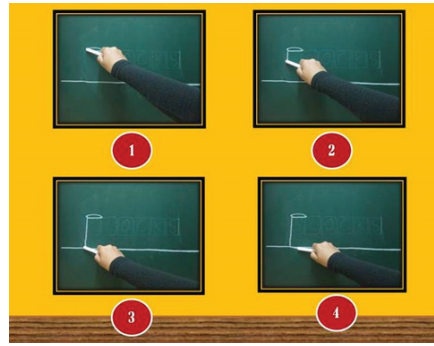


Figure 8. Process of Capturing the Movements.

Source: Author

The process was continued until it was enough to portray the movements. The more frames, the smoother the activities would appear.

h.Making it into a movie

As mentioned earlier, the images were compiled in movie maker software to create movements. Speed and duration were adjusted accordingly. The video for the study lasted thirty-three seconds and was used to complement the teachers' instructions. In addition, sound effects and songs suitable for the story and movements were inserted during the process.

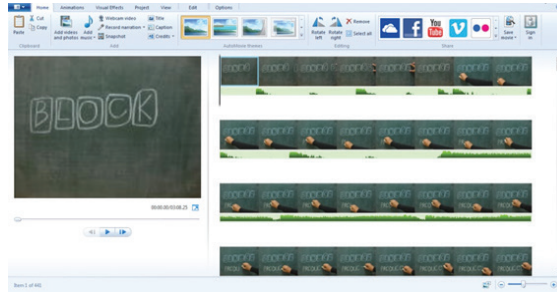


Figure 9. Screenshot of the Editing Process

Source: Author

This phase is an important one as one could edit it. Careful editing could create an amazing animation.

FINDINGS

Before using the animation video, the target audience was asked to answer a simple questionnaire about whether they had experienced learning from animation, and if they enjoyed their science lessons. This was considered the initial analysis phase. The animation that was created was shown to the students for their feedback. More than half of the participants said that animation was not used in Science class from the analyzed data. Even though 37% said 'yes', further questioning of some of them revealed that they were unsure. Moreover, some students (10%) claimed that they felt bored during the Science lesson because it was 'dull', 'boring', and lack of humor. Although the percentage is small compared to a large portion of 90% of respondents who said that they enjoyed learning during Science class, these small voices must be addressed. The purpose of this study was to demonstrate how a stop motion animation could be created for a science class to enhance their learning experience through fun and enjoyable animation.

After the video was shown to them, all (n=30, 100%) of the learners agreed that the animation was simple, fun, and easy to understand. The video entitled 'e-SMART' showed the differences between animal and plant cells, and within thirty-three seconds of the animation, the students felt enticed to watch from the beginning until the end. In addition, all of them agreed that the e-SMART video should be used during Science class. 97% of the respondents stated it could help them learn Science better because they could understand the lesson well. Thus, this positive feedback was given to the teacher that the stop motion animation was a tool that could complement the teacher's effort.

What is the level of usability of the animation that has been developed?

The final stop motion animation video e-SMART showed the differences between animal and plant cells in just thirty-three seconds. After the video was shown to the students, the teacher delivered another

questionnaire just to gauge their learning experience. A question was asked: ' What did you gain after watching the Stop Motion animation about Form One Science, Topic 2 just now?' Respondents (n=26) answered that animal cells did not have chromoplast, vacuole, or cell wall, but plant cells did. The answers given were correct as the difference between both cells is that animal cells do not have chloroplast, vacuole, and cell wall, while plant cells have all the animal cell characteristics, including those three differences (Irwan, 2013). Each of the 26 respondents explained their answers differently but arrived at the same observation. The remaining four respondents specifically stated how the e-SMART video made them understand the differences between those two cells. This allowed the researchers to conclude that all the students benefitted from the animation video. The brief questions posed to the students before and after the lesson indicated that the students found the stop motion video aided their understanding.

CONCLUSION

Every teacher needs teaching aids to assist them during the teaching and learning process in the classroom, just like a disabled person who could benefit from using a wheelchair or cane to walk from one place to another. Traditional teaching aids are still used these days, e.g. manila cards and mah-jong papers. Some teachers use presentation slides created via Microsoft Powerpoint and project the media through a classroom or computer lab projector. This study demonstrated how a stop motion animation could be created for a science lesson to complement the teachers' strategies in the science classroom. While some teachers who are less technically savvy may detest the use of multimedia and continue to use traditional ways of teaching, this study demonstrated that with some effort and creativity, they too could produce teaching materials that could be fun and appealing to their students.

The concept of creating the e-SMART video is simple. All it takes is a projector in the computer lab or library but is limited to the classroom. Not every classroom in Malaysian public schools is provided with a projector and LCD screen, as Noraziah and Noor Mazlan (2011) stated. Nonetheless, the stop motion animation can be shown to the students by using teachers' tablets or laptops as teachers in Malaysia were equipped with one (Farezza

H.R., 2016). Teachers could show it to them in groups or find other ways to do so such as uploading and sharing it on VLE Frog, a learning platform that is made available free for teachers, students, and parents. The findings of this study show that a brief lesson of thirty-three seconds could entice learners to learn about a topic, and ideally discover related information more independently.

Hence, it can be a self-learning mode for students. As the process of producing the animation is based on the ADDIE Model and includes elements of multimedia, teachers could construct lesson plans and further activities based on it. The onus is on teachers to heed the call to prepare learners in line with Industry Revolution 4.0 and UNESCO's Sustainable Development Goals that encourage the use of digital technology (Maaruf, Nik Anuar, and Supramaniam, 2021). With constant technological development, teachers should be creative and innovative in incorporating technology in their teaching approaches. Without such input, students may find lessons routine and boring.

ACKNOWLEDGEMENT

The authors would like to express their appreciation for the support given to those involved directly and indirectly in this study.

FUNDING

There is no funding for this research.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

All authors contributed to the design of the research, the questionnaire, and the write-up. The on-line survey, data cleaning and tabulation was

undertaken by researcher. All authors have read and approved the final manuscript.

REFERENCES

Becker, T. (2014). *What Are the Advantages & Disadvantages of Non-Experimental Design*? Retrieved December 10, 2016, from http://www.ehow.com/info_8078209_advantages-disadvantages-nonexperimental-design.html.

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics, 5*(1), 1- 4. https://doi.org/10.11648/j.ajtas.20160501.11

Forest, E. (2014). *The ADDIE Model: Instructional Design*. Retrieved August 12, 2016, from http://educationaltechnology.net/the-addie-model-instructional-design/

Lee, M. N. N. (2004). *Malaysian teacher education into the new century.* In Y. C. Cheng, K. W. Chow, & M. M. C. Mok (Eds.), Reform of teacher education in the Asia-Pacific in the new millennium: Trends and challenges, Education in the Asia-Pacific Region: Issues concerns and prospects, vol 3 (pp. 81–91). Dordrecht: Springer.

Mahmud, S.N.D., Nasri, N.M., Samsudin, M.A. et al. (2018). Science teacher education in Malaysia: challenges and way forward. *Asia Pac. Sci. Educ. 4,(8)*. https://doi.org/10.1186/s41029-018-0026-3.

McGriff, S. J. (2000). *The Challenges Faced by Science Teachers When Teaching Outside Their Specific Science Specialism.* Instructional Systems, College of Education, Penn State University. Retrieved November 10, 2016, from https://www.lib.purdue.edu/sites/default/files/directory/butler38/ADDIE.pdf.

McCarthy, H (1999). *Hayao Miyazaki: Master of Japanese Animation.* United States, America.

Keithellakpam B. (2016) The Problems Faced in Teaching Science in

The High Schools of Manipur, India (2016). IJSR - *International Journal Of Scientific Research 5*(3), ISSN No 2277–8179, IF: 3.508, IC Value: 69.48. https://www.worldwidejournals.com/international-journal-of-scientific-research-(IJSR)/recent_issues_pdf/2016/March/March_2016_1492754022__143.pdf

Malaysia Ministry of Education (2013). *Malaysia education blueprint 2013–2025*. Putrajaya: Ministry of Education.

Mizzi, D. (2013). The Challenges Faced by Science Teachers When Teaching Outside Their Specific Science Specialism. Acta Didactica Napocensia, 1-6. *Cluj-Napoca 6*(4), 1-6. Babes Bolyai University, Didactics of Exact Sciences Chair. EISSN-2065-1430.

Mohd Nor Peah, M. Z. (2012). *Aku & Pendidikan Seni Visual.* Retrieved August 12, 2016, from http://zact73.blogspot.my/2012/02/animasi.html

Irwan (2013). *Nota Sains Tingkatan 1* [Bab 2- Sel Sebagai Unit Kehidupan]. Retrieved.December 13, 2016, from https://www.scribd.com/doc/241975353/Nota-Sains-Tingkatan-1-Bab-2-Sel-Sebagai-Unit-Kehidupan-BLOG-CIKGU-IRWAN-pdf.

Ivan Teh (2013), *ADDIE Model chart Source*. Retrieved from: http://www.leadertipsforsuccess.com/attachments/Image/ADDIE.jpg

Kassim, N., & Zanzali, N. A. (2011). *Penggunaan ICT Dalam Pengajaran* dan Pembelajaran Matematik di Kalangan Guru-guru Pelatih UTM. Retrieved December 23, 2016, from http://eprints.utm.my/10133/1/Noraziah_binti_Kassim@Aziz.pdf

Md Abas, Siti Syazila (2014). *The Development of Stop Motion Animation in Learning Animation Among the Art and Design Education Students*. 1-95.

Olayinka, A. B. (2016). Effects of Instructional Materials on Secondary Schools Students Academic Achievement in Social Studies in Ekiti State, *Nigeria, 6*(1), 32–39. http://doi.org/10.5430/wje.v6n1p32.

Rasheed, F. H. (2016). *2017 Budget: Free tablets for teachers to assist in teaching*. New Straits Times. Retrieved December 23, 2016, from http://

www.nst.com.my/news/2016/10/182285/2017-budget-free-tablets-teachers-assist-teaching.

Sengul, S. H., Cetin, G., & Gur, H. (2008). The Primary School Science Teachers' Problems in Science Teaching. *Journal of Turkish Science Education,5*(3), 82-88. Retrieved December 12, 2016, from https://www.pegem.net/dosyalar/dokuman/48106-20090429101220-07the-primary-school-science-teachers--problems-in-science-teaching.pdf.

Singh, S. (2011). *Teaching aids in classrooms – both the traditional and the modern*. Retrieved October 15, 2016, from http://www.indiastudychannel.com/resources/146408-Teaching-aids-in-classrooms-both-the-traditional-and-the-modern.aspx.

Siti Zuraida Maaruf, Aliza Mohd Salleh & Noor Farhani Othman (2019). The Development of ARTHIS Interactive Module in Teaching and Learning Art History. *Social and Management Research Journal, 16* (2). Retrieved from https://doi.org/10.24191/smrj.v16i2.7063.

Siti Zuraida Maaruf, Nik Nur Nabihan Binti Nik Anuar and Kaarthiyainy Supramaniam (2021) In Motion: Using Stop-Motion as Supplementary Teaching Material for Secondary School Learning. *International Journal of Creative Research Thoughts (IJCRT). 9*(2) | ISSN: 2320-2882.

Smith, S. (2016). *5 Components of Multimedia.* Retrieved September 12, 2016, from http://smallbusiness.chron.com/5-components-multimedia-28279.

Supramaniam, K., Nazer, A. M. & Maaruf, S. Z. (2020). Teachers' Lived-Experience in a Dual High-stakes Examination System. *The European Journal of Social & Behavioural Sciences, 29*(3), 154-170. https://doi.org/10.15405/ejsbs.279.