



VIDEO  STEM



TEACHERS' PERCEPTION OF USING STEM VIDEO FOR TEACHING AND LEARNING

A REPORT



UTM
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Teachers' Perception of Using STEM Video for Teaching and Learning: A Report

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Executive Summary

The increasing number of Malaysia students who refused to choose science, technology, engineering and mathematics (STEM) related courses for secondary education has drawn national's concern. As Malaysia is moving forward to be a developed country, the availability of human resources in STEM-related areas is crucial. STEM video project is one of the initiatives to promote STEM learning and STEM concept understanding in a more engaging way. However, this initiative demands the collaboration from all stakeholders such as the teachers. Hence, this report presents the findings on teachers' perception about using STEM video for teaching and learning based on a survey administered to 800 STEM teachers in Malaysia.

1 Background and Research Approach

Research shows that the number of students enrolling in Science-related courses is decreasing (Halim & Meerah, 2016) which may due to several factors such as lack of interest (Osborne, Simon & Collins, 2003) and perception that science-related subjects are difficult (Checkley, 2010). Studies found that the quality of teaching in science-related areas is also one of the determinants of students' interest in learning the subject (Osborne, Simon & Collins, 2003).

Science, Technology, Engineering and Mathematics (STEM) Video focusses on making STEM learning more interesting while ensuring that concept about science is explained in relation to students' real-life application. Universiti Teknologi Malaysia participated in MIT-BLOSSOMS Project in 2015 where BLOSSOMS project emphasized on teaching the abstract and difficult STEM concepts through a series of active learning activities and video segments termed as 'teaching duet' (Larson, 2009). This idea is

further integrated in STEM Video Project, a collaboration project between Project STEMazing, UTMLead, Universiti Teknologi Malaysia (UTM) and Ministry of Education, MoE starting the year 2016.

In 2016, ten (10) STEM videos were developed by Project STEMazing, UTM while eight (8) other videos were developed by teachers assisted by MoE. These videos were introduced to teachers throughout Malaysia in a six-series of seminars conducting in six different zones in Malaysia, namely Selangor, Johor, Sabah, Sarawak, Kedah and Terengganu.

In the seminar, a survey design study was administered to investigate teachers' perception about STEM Videos based on its usefulness, readiness, ease of use and acceptance towards using the video in their classrooms. At every zone, teachers were grouped into smaller groups where they have to watch the assigned videos in groups. Next, they answered the questionnaires. A total of 800 questionnaires were distributed which results in 684 returned questionnaires.

2 Introduction and Context

Students' reluctance to choose Science-related stream for their secondary education starting the year 2015 to 2016 has affected the national education agenda. In Pelan Pembangunan Pendidikan Malaysia 2013-2025, the need for enhancing STEM is clearly underscored with many STEM initiatives being in the pipeline (Kementerian Pendidikan Malaysia, 2013).

STEM Video Project stems from this commitment. It builds from an architecture that is written based on STEM concepts that teachers perceived as difficult to explain or concepts that students frequently misunderstood. It consists of Introduction Segments, Activity Segments, Video Segments and a Teacher's

Guide segment that tells teachers about how to use the video. The refined STEM Video development process is shown in Figure 1.

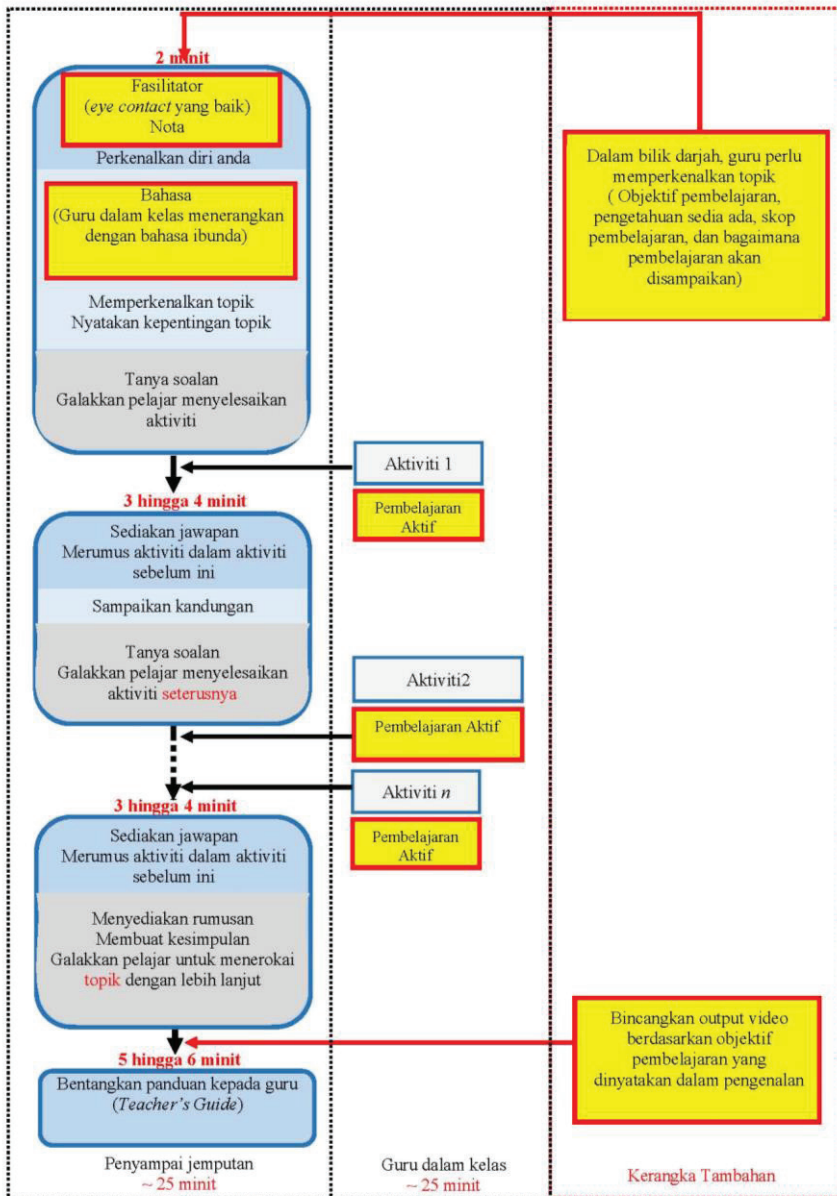


Figure 1. STEM video development process

Teachers developed the architecture based on the development process (see Figure 1) and later developed the videos through video shooting processes. The developed STEM Videos by teachers in 2016 are shown in Table 1.

Table 1. STEM videos developed by UTM and MoE

Area	Video STEM Title
Information and Communication Technology	Database Is Awesome*
Chemistry	Diffuse Or Not To Diffuse?*
Chemistry	Makin Kecil Makin Cepat*
Engineering Drawing	Elips*
Mathematics	Bang! Bang! Binomial!*
Mathematics	Popcorn Anyone?*
Mathematics	Kenduri Pola*
Science	Tuaskan Saja*
Science	When The Breeze Blow*
Science	Keberatan Jisim*
Biology	Watch Out! CKD
Biology	Sinaps
Physics	Gasing oh Gasing!
Science	To Float or Not to Float
Chemistry	Mikrob Kecil-kecil Cili Padi
Mathematics	Kecerunan Aduh Penatnya
Chemistry	Berkaratnya Pagar Rumah Saya
Physic	Terapung Tak Hanyut, Tenggelam Tak Basah

*Videos developed by UTM

All the videos were uploaded to www.eduwebtv.com. In these videos, some of the concepts were explained while relating Science and Maths, Chemistry and Physics while there were also videos which explained concepts by STEM disciplines (Science, Technology, Engineering and Maths).

Previous studies about BLOSSOMS videos show that BLOSSOMS videos can improve students' level of critical thinking and understanding about science concept (Hamizan & Zaid, 2014)

yet to fully utilize and integrate these videos in Malaysia curriculum system is a challenge (Abdullah & Shukor, 2017). These videos can greatly shift teaching STEM paradigm in Malaysia schools but comprehensive understanding about teachers' perception towards using video technology for STEM teaching has to be carried out.

Hence, to provide deeper understanding of teachers' intention to use STEM videos this study explores teachers' perception about STEM Videos based on its usefulness, teachers' readiness, ease of use and teachers' acceptance towards using the video in their classrooms. These constructs were based on TAM model (Davis, 1989) which measures how users accept and use a technology. In TAM model, users' perceived usefulness and perceived ease of use are hypothesized to be the fundamental determinants of user technology acceptance. In detail,

- perceived usefulness is user's subjective belief that using a technology could improve job productivity and efficiency
- ease of use is user's belief that using a technology will be free of effort

In many studies, it was reported that perceived usefulness has direct and indirect effects towards behavioural intention. That is, a teacher has the tendency to use technology if he/she perceives technology to be a useful and meaningful way to work more effectively.

Drawing on the constructs as well as collecting additional qualitative demographic data, this study was designed to investigate the following:

- What is the teachers' perception to use STEM Video as one of the tools for teaching and learning based on level of readiness?

- What is the teachers' perception to use STEM Video based on its usefulness?
- What is the teachers' perception to use STEM Video based on its ease of use?

This report is the final report on the outcomes of this evaluation.

3 The Evaluation Approach

A survey approach was used in this study using a set of questionnaire containing the following six (6) sections:

- Section A: Demographic Information,
- Section B: Teachers' perception to use STEM Video as one of the tools for teaching and learning based on their level of readiness,
- Section C: Teachers' acceptance to use STEM Video
- Section D: Teachers' Perception to use STEM Video based on its usefulness
- Section E: Teachers' perception to use STEM Video based on its ease of use,
- Section F: Suggestion and Recommendation

Teachers teaching in secondary schools in Malaysia have to sit for a diagnostic test called *Penilaian Kompetensi Guru Bidang STEM*. These teachers were randomly selected to attend a seminar that introduced the teachers to STEM Videos.

There were a total of six seminars being conducted throughout Malaysia where in every seminar teachers were grouped into smaller groups and assigned one STEM Video to be reviewed. After watching the STEM Video, they have to answer the questionnaire investigating about their perception on using STEM Video for teaching and learning.

The collected quantitative data were analysed using statistical software, IBM Statistical Package for Social Science (SPSS)

version 22 while qualitative data were analysed using QDA Miner Lite software.

4 Teacher's Background

In this study, the selected teachers teach Science, Mathematics, Engineering or Technology-related subject (eg. *Lukisan Kejuruteraan*) in secondary schools and were experienced teachers with most teachers having more than 10 years of working experience (69.21%) and at least 25% teachers have 6 to 10 years of teaching experience (see Table 2).

Table 2. Teachers' teaching experience

Teaching Experience (Years)	1-2 years	3-5 years	6-10 years	More than 10 years
Percentages (%)	1.61	3.67	25.51	69.21

While majority of the teachers were mostly computer literate (75.6%), only small percentages did not know about using the combination of Microsoft Office, Web Browser and Social Network (see Table 3).

Table 3. Teachers' computer skills

Computer Skills	Microsoft Office	Web Browser	Social Network	Any Two Skills	All Skills
Percentages (%)	5.3	7.7	2.7	8.6	75.6

5 The Findings

This section draws together the qualitative and quantitative data gathered from all participants, along with data from participants' comments and suggestions to provide a better understanding about teachers' perception.

Teachers' Perception to use STEM Videos based on Level of Acceptance

Generally, teachers agree to use STEM video in the future and have the tendency to promote STEM video for others to use but agreement to use STEM video regularly is quite low. However, they believe that STEM video provides more interactive teaching and learning (see Table 4).

Table 4. Teachers' perception to use STEM videos based on level of acceptance

Item	n	Min	Max	Mean	Standard Deviation
I am interested in developing and using information in STEM Video	677	1.00	5.00	3.76	0.82
I will use STEM Video in the future	679	1.00	5.00	4.04*	0.70
I plan to use STEM Video regularly	677	1.00	5.00	3.64*	0.82
STEM Video makes teaching and learning more interactive	679	2.00	5.00	4.14*	0.72
Teaching with STEM Video encourage students to give more attention to me	678	1.00	5.00	3.79	0.82
Teaching with STEM Video is simple	678	1.00	5.00	3.93	0.76
Using STEM Video did not bores me	664	1.00	5.00	3.88	0.80

I intend to inform and show others about STEM Video	680	1.00	5.00	4.09*	0.69
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Teachers' Perception to Use STEM Videos based on its Usefulness

Although teachers generally accepted the use of STEM videos for teaching and learning, they did not strongly agree that STEM video allows them more time and freedom to observe students' learning activity. However, they strongly believe that STEM video could serve as an important tool to help them with teaching concepts in STEM (refer to Table 5).

Table 5. Teachers' perception to use STEM videos based on its usefulness

Item	n	Min	Max	Mean	Standard Deviation
STEM Video will enhance the effectiveness of my teaching process	680	2.00	5.00	4.01*	0.68
STEM Video will improve my efficiency of teaching concept that is difficult to understand	678	2.00	5.00	4.05*	0.72
STEM Video will allow me to easily observe student learning activity	678	2.00	5.00	3.93	0.73
STEM Video will allow me to easily manage my teaching	680	1.00	5.00	3.91	0.74
Learning activities in STEM Video will make my teaching more meaningful	680	1.00	5.00	4.00*	0.69
STEM Video makes it easier for me to teach STEM concept	680	2.00	5.00	4.02*	0.71
STEM Video as a useful tool in teaching and learning STEM	679	2.00	5.00	4.12*	0.68

Overall, I find that STEM Video as beneficial for my teaching	675	2.00	5.00	4.09*	0.65
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Teachers' Perception of using STEM Videos based on its Ease of Use

In this study, teachers were introduced to STEM videos by demonstration and they have lack of experience in using STEM videos. This setting has greatly affected teachers' perception about using STEM video based on its ease of use. Findings show that their belief that using STEM video is free of effort is at low level. This is reflected in item 'I find that it is easy to fully utilize STEM video' which has mean = 3.65 indicating low agreement (refer to Table 6).

Similarly, lack of time to fully watch STEM video during demonstration (in seminar) probably affected their belief that they have to frequently watch the Teacher's Guide to fully understand the content of STEM video (mean = 3.54). But, it clearly shows that teachers believe the availability of Teacher's Guide segment in STEM video is important as it would assist teachers to use STEM video in the classroom (mean = 3.94).

Table 6. Teachers' perception to use STEM videos based on its ease of use

Item	n	Min	Max	Mean	Standard Deviation
I find that it is easy to fully utilize STEM Video	680	1.00	5.00	3.65*	0.81
I find that STEM Video allows flexibility to interact with students and other teachers	679	2.00	5.00	3.83	0.68
I find that STEM Video allows flexibility to interact with	679	2.00	5.00	3.86	0.67

I did not get confused when I use STEM Video	671	1.00	5.00	3.79	0.69
I did not need to consult the teachers guide frequently when using STEM Video	679	1.00	5.00	3.54*	0.83
I can fix the problem of understanding STEM related concept when using STEM Video	679	1.00	5.00	3.89	0.70
STEM Video provides helpful teachers' Guide in assisting the usability in the classroom	664	1.00	5.00	3.94*	0.71
Interacting with STEM Video did not require a lot of my mental effort	669	1.00	5.00	3.72	0.77
Overall, I find it easy to teach using STEM Video	669	1.00	5.00	3.89	0.72

Teachers' Perception of using STEM Videos as one of the tools for teaching and learning based on Level of Readiness

As pointed out by Abdullah and Shukor (2017), integrating STEM video in Malaysia curriculum is a challenge among the teachers due to time-constrained and current exam-oriented system which limits teachers' possibilities to use other reference materials for teaching and learning than textbooks. This study found that teachers' level of readiness to use STEM video is quite low but they believe that STEM video improves their own understanding about STEM related concept (refer Table 7). This is an important indicator of the quality of video content in STEM video which can promote teachers' understanding about Science, Maths, Engineering and Technology content and concepts.

Table 7. Teachers' perception to use STEM videos based on level of readiness

Item	n	Min	Max	Mean	Standard Deviation
I am willing to use STEM Video for strengthening students' understanding in Science or/and Maths concept	680	1.00	5.00	3.65	0.81
I am willing to use STEM Video for teaching tool for a teaching session	679	2.00	5.00	3.83	0.68
I am willing to use STEM Video additional information to improve my own understanding about STEM related concept	679	2.00	5.00	3.86*	0.67
I am willing to use STEM Video to increase student interaction in STEM class through activities in STEM video	671	1.00	5.00	3.79	0.69
I am willing to use STEM Video to replace my teaching method related to STEM	679	1.00	5.00	3.54*	0.83

The Potential of using STEM Video to Assist Teaching and Learning

In a structured question, teachers were asked about the potential of using STEM Video to assist their teaching and learning. Most teachers agreed that STEM video has the potential to ease the teaching and learning process while a very small percentage of teachers disagreed and some of the teachers also indicated 'Yes and No' for a couple of reasons (see Table 8).

Table 8. Percentage of agreement about the potential of STEM Video to ease teaching and learning

Agreement	Yes	No	Yes & No
Percentages (%)	96.8	2.5	0.4

Using word cloud, keywords were generated from teacher' responses about why STEM Video has the potential to assist teaching and learning. This study found that teachers believed that STEM Video has quality video content mainly because students are able to see the relationship between the concept and real-life application thus motivating them to learn the subject (see Figure 2).



Figure 2. Word cloud on the potential of STEM Video to assist teaching and learning

In their opinion, teachers can act as facilitators to assist teaching and learning process thus time saving and teachers can focus more on monitoring students' understanding during learning in the classroom.

However, some teachers have perception that they have limited time in using STEM Video and they fear that students will be more confused without proper introduction and relating to students' prior knowledge.

Some teachers were also undivided (Yes & No) in deciding whether STEM Video can assist them in teaching and learning because they believe that teaching concepts through videos is useful but easy concepts can be well-explained in classroom rather through videos. They indicated that part of the videos is very useful but they prefer the explanation to be shortened if the concept is better explained face-to-face. This is supported by the following statement:

“Ya. Untuk topik yang perlu gambaran atau lukisan yang rumit, video boleh show dengan jelas bertambahan dengan pergerakan. Tidak, topik yang mudah agak bazir masa. Sesetengah topik boleh jelas tanpa bersemuka dengan pelajar.”

They also pointed out that some videos had too many concepts within one segments' explanation which leads to more confusion. They also valued more hands-on activities among the students compared to question and answer sessions in the video segments that could be easily done in face-to-face teaching and learning session.

Usability of STEM Video to Improve Students Understanding about 'Concept'

This study found that the quality video content (see Figure 3) plays the most important role in improving students' understanding about 'concept' because the demonstration of the concept is clearer in relation to real-life application with the aid of animation, detailed explanation and relevant hands-on activities.

The teachers mentioned the followings:

“Video STEM ini menunjukkan dengan jelasnya setiap konsep tersebut dan ditamatkan dengan penerangan, animasi, suasana video akan meningkatkan pemahaman konsep”

“Konsep sains dinyatakan dengan jelas dalam video stem, sepatutnya pelajar boleh faham konsep dengan baik.”

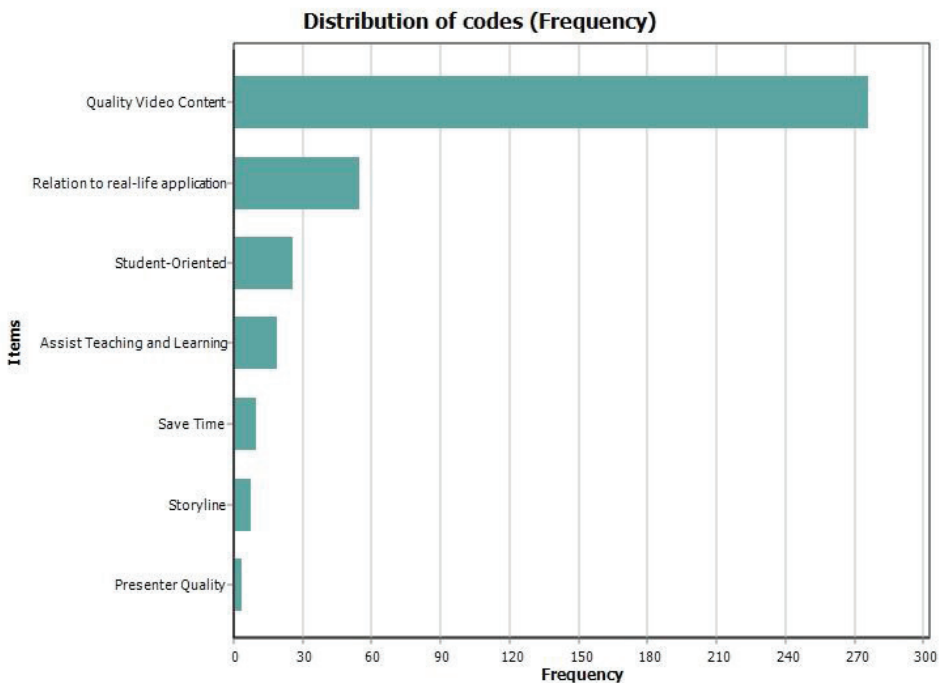


Figure 3. Teachers' perception about the usability of using STEM Video to improve students understanding about 'Concept'

The teachers also pointed out the importance of treating the video content with caution because teachers have to first understand their students' current level of understanding to avoid further misconception. The teachers mentioned the following:

“Menarik tapi perlu perbaiki. Sesuai untuk pembinaan konsep tetapi perlu dibintangi secara terperinci oleh guru subjek. Misconception juga boleh berlaku melalui video.”

“Guru perlu menjadi pemudahcara untuk memberi lebih pemahaman kerana tidak semua pelajar dapat mengaitkan aktiviti dengan konsep secara sendiri.”

Limiting Factors in Using STEM Video for Teaching and Learning

Among the reasons that limit teachers' intention to use STEM video are tools, time and internet access (refer Figure 4). Teachers believe in many schools, limited tools and infrastructure such as projectors, monitors, computers and internet access will limit their capabilities to use digital learning resources such as STEM videos. Although very few cases, these limitations remain an issue in selected rural areas such as Sabah and Sarawak.

Other than that, they argued about time constraint where they had to cater administration works and their duty to complete syllabus in due time. In fact they doubt that using STEM Video would further drag their time in finishing the syllabus on time. They mentioned the followings:

“..kesukaran untuk menghabiskan silibus yang ditetapkan (melambatkan untuk habis sukatan yang perlu diajarkan). ”

“Tidak boleh digunakan dengan kerap kerana menyebabkan silibus tidak boleh diselesaikan ikut masa.”



Figure 4. Possible barriers to use STEM Videos

Improving STEM Video

Figure 5 shows that most teachers argued about the video editing quality of STEM video which should be improved. Although they believe that STEM video has quality video content, video editing quality has to be improved. They identified that some of the videos were recorded at crowded areas where explanation by the presenter can be hardly heard. One of the teachers mentioned the followings:

"..pemilihan lokasi penggambaran yang tidak bising/ gangguan bunyi dari persekitaran."

They also pointed out the importance of the presenter that plays the role as the STEM video presenter as someone who should possessed good presentation skills so that the delivered content can be clearly understood to avoid confusion and further misconception. The teachers mentioned the followings:

“Peranan guru sebagai penyampai maklumat perlu lebih menarik, menggunakan intonasi suara yang sesuai, tidak terlalu mendatar suaranya.”

Another important note on improving STEM Video is there is a need for continuous quality assurance and research on STEM video development. One of the teachers pointed out the following:

“..dibentuk satu kumpulan pembangunan STEM pusat dibuat video berdasarkan keperluan, edar ke sekolah, hasil keputusan diambil dan dikaji semula, buat video baru untuk atasi kelemahan”.

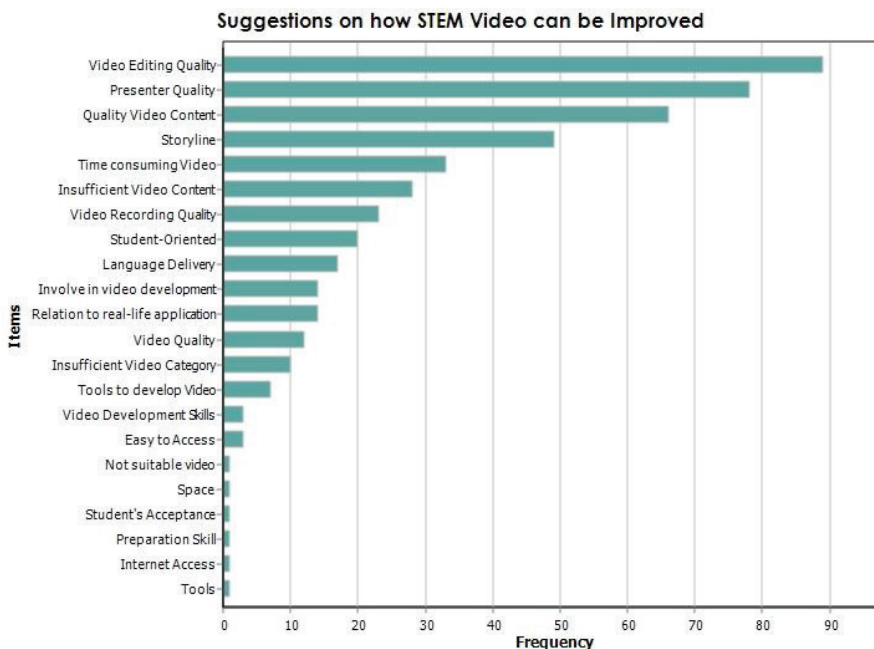


Figure 5. Teachers' suggestions on how STEM video can be improved

Quality assurance is important to make sure that the desirable functions and performance meets the standard (Boehm, Brown, & Lipow, 1976). For multimedia application such as video, users have to know what is good for them (Wilson & Sasse, 2000) and this can be achieved by pilot testing and research.

6 The Future of Video STEM in Teaching and Learning

For many teachers, the use of STEM Video was relatively new but teachers have the opportunity to access to alternative materials in teaching STEM. For STEM Video to be sustainable, several measures should be taken into consideration which includes maintaining quality of the video content which can greatly affect students understanding about a concept in STEM and the change of teachers' role in classroom.

The Impact on Teaching Practice

During the development of STEM video, teachers had changed of mind set about the importance of providing students with the very basic facts about science, maths, engineering and technology and relating them to real-life applications. Teachers recognized that to be able to provide quality teaching, they have to be able to think critically and fully-equip and update themselves about content knowledge in STEM in daily life activities.

Other than while using STEM video as a learning resource, they believe that they could also improve their own understanding about science concept while watching STEM videos. Hence, the development of STEM video in the future should follow proper

guidelines and more importantly the video has to be content validated by the subject matter experts.

The most significant when using STEM videos is the changing teacher/student relationship. While the availability of STEM videos could lead to student-centered learning, the role of the teachers as facilitators remains crucial before, during and after the learning sessions. STEM video allows teachers more room for monitoring students' learning during teaching and learning sessions. However, they did not deny the additional workload before learning with STEM video where they have to critically select and understand the STEM video content which they perceived as time consuming. As such, proper strategies have to be formulated so that teachers are educated on the ways they can leverage on STEM videos in their classroom.

The Impact on Student Learning

Although this project did not measure students' direct involvement and the effect of STEM Videos on their learning, using STEM video for teaching and learning will greatly change students' learning environment.

With the shift towards student-centered learning, students will have more opportunities to collaborate, interact and get hands-on experience through activities in STEM videos. They have to be educated that they no longer play passive role during learning but hold the responsibility as the creator of knowledge in the classroom which makes learning more motivating (Hamizan & Zaid, 2014).

7 Conclusion

Conclusively, teachers believed that using STEM Video for teaching and learning was acceptable and they perceived STEM video as beneficial for teaching and learning as well as for themselves but found it as quite a challenge to use it in the classroom due to several infrastructure and other limiting factors. For sustainability, these issue lead to slim chances that the teachers are ready to use STEM videos if the barriers remained in the next few years.

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