

# USING SCRATCH PROGRAMMING TO ENGAGE PRIMARY SCHOOL PUPILS IN COMPUTATIONAL THINKING

## *Penggunaan Scratch Programming untuk Meningkatkan Penglibatan Murid Sekolah Rendah dalam Pemikiran Komputasional*

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### ABSTRACT

The aim of this study is to determine pupils' understanding of the multimedia elements; and to find out to what extent the pupils are engaged in computational thinking in the learning process. This study uses the ASSURE model and Computational Thinking concept; and data were collected using questionnaire, interviews and observations. A multimedia presentation based on Scratch Programming was developed and used as an instructional model for this classroom investigation. The participants of this study consist of 36 Year 4 primary school pupils. Analysis of the pupils' responses indicated that they were able to identify the elements of multimedia, functions of multimedia and the file format of the elements used in the Scratch Programming. Additionally, the pupils were found to be engaged in computational thinking such as decomposition and algorithmic thinking and were observed to participate actively in the learning process. Hence, this study implies that by incorporating multimedia and computational thinking in the classroom, learning can be enhanced through increased motivation and meaningful interaction using Scratch Programming.

**Keywords:** *scratch programming, computational thinking, multimedia.*

### ABSTRAK

*Tujuan kajian ini adalah untuk menentukan pemahaman murid mengenai elemen multimedia; dan untuk mengetahui sejauh mana murid terlibat dalam pemikiran komputasi dalam proses pembelajaran. Kajian ini menggunakan model ASSURE dan konsep Pemikiran Komputasi; dan data dikumpulkan melalui soal selidik, temubual dan pemerhatian. Satu persembahan multimedia yang berdasarkan Program Scratch telah dibina dan digunakan dalam menjalankan penyelidikan ini. Peserta kajian ini terdiri daripada 36 murid-murid sekolah rendah Tahun 4. Dapatan dari analisis data menunjukkan bahawa murid-murid dapat mengenal pasti unsur-unsur multimedia, fungsi multimedia dan format fail unsur-unsur yang digunakan dalam program tersebut. Di samping itu, dalam pemerhatian yang dibuat murid-murid yang terlibat dalam pemikiran komputasi seperti decomposition dan algorithmic thinking, telah bekerjasama dengan sangat aktif dalam proses pembelajaran. Kesimpulannya, kajian ini menunjukkan bahawa pembelajaran murid-murid boleh dipertingkatkan dengan mengintegrasikan Scratch Program di mana murid-murid berinteraksi dengan lebih aktif dan bermotivasi tinggi.*

**Kata kunci:** *scratch programming, pemikiran komputasional, multimedia.*

## INTRODUCTION

Technically computer-based learning is commonly used in today's technology advanced and globally connected world. Hence, the need to introduce computing ideas to students at an early stage is most essential, such as during their schooling years. Computational thinking aligns with the need for students to become media information literate, which includes understanding how information and data can be represented to convey different meaning. Computational thinking is a problem-solving skill set, which includes problem solving, decomposition, algorithmic thinking, abstraction, and automation (Wilson, C., Grizzle, A., Tuazon, R., Akyempong, K., & Cheung, C. K., 2013).

The recent issues raised in the Malaysian Education System showed that our government is determined to integrate computational thinking into the country's school curriculum. We intend to transform the classroom to keep up with technological trends. Therefore these trends have been recognised and was being implemented under one of the 11 shifts listed in the blueprint for preschool to post-secondary education. These steps taken will help to stimulate the development of essential life skills like computational thinking along with communication, collaboration, critical thinking, creativity and curiosity. Computational thinking is not only related to ICT subjects but is also encompassed in the teaching of other subjects taught in schools. In the 21st century, it is not an easy task to implement the use of technology in education as an additional tool to further enhance Information Communication and Technology (ICT) learning and competency as well as to equip pupils with critical thinking skills. The integration of multimedia into the classroom can increase awareness towards the benefits of using the technology. One of the indisputably advantage of integrating multimedia is the ability to cater to pupils' learning preferences as it incorporates the five elements of multimedia: text, audio, graphic, animation as well as video. Pupils coming from diverse background are individuals with different learning preferences. Thus, by incorporating multimedia into the lessons may help fulfil pupils' different learning styles and diverse needs simultaneously. In view of this, this study aims to determine pupils' understanding of the multimedia elements; and to find out to what extent the pupils are engaged in computational thinking in the learning process. The ASSURE model and Computational Thinking concept were adopted to help in the classroom investigation of the Year 4 primary school pupils.

Specifically, the two main aims of this study were :

- i. To determine pupils' understanding of the multimedia elements;
- ii. To find out to what extent the pupils are engaged in computational thinking in the learning process.

Hence in order to determine pupils' understanding of the multimedia elements, the procedure taken by the researchers were by engaging pupils in computational thinking and making them find the elements of multimedia and its function in the multimedia presentation. The tasks were focussed on:

- i. Identifying the elements of multimedia in the presentation.
- ii. Stating the function of each type of elements of the multimedia in the presentation.
- iii. Classifying the file format for each type of elements of multimedia used in the presentation.

To further investigate into the pupils' engagement to computational thinking in the learning process, the ASSURE model was employed. (Figure 1). The steps taken using the ASSURE model and the integration of the Computational Thinking concept is discussed in detail in the Methodology section.

## LITERATURE REVIEW

The use of multimedia in education has proven its importance due to its positive impact on the teaching and learning process. Multimedia with its interactive nature, is multi-sensory which means that it is able to stimulate multiple senses of the audience at a time. Gilakjani (2012) stated the rationale and the three main reasons for the use of multimedia in the classroom. According to him, its use increases students' interest level, enhances their understanding, and increases their memorizing ability. Multimedia is an innovative and effective teaching and learning tool because it motivates students in their learning process and helps them to understand the information presented. Additionally, it helps teachers to present information in an effective way (Shah & Khan 2015).

Multimedia is one of the best educational techniques because it addresses more than one sense simultaneously, as it addresses the senses of sight and hearing. Multimedia programs provide different stimuli in their presentations which include a number of elements some of which are texts, spoken words, sound and music, graphics, animations and still pictures (Aloraini, 2005)

Multimedia is impactful in the teaching and learning process, hence it is of utmost importance to maximise use of multimedia in the classroom. However, a good selection of multimedia elements is needed to produce a good multimedia presentation. Besides that, the knowledge of inserting and arranging all the multimedia elements in the presentation play an equally vital role.

Pupils today are spoilt for choice in terms of the tools, either conventionally or unconventionally, which can be used in the learning process. The pupils have ample possibilities of using traditional teaching tools such as books, paper, pencils and making use of them to copy notes from the board. They were observed to be reluctant to put their effort to utilize the more current and effective technology particularly multimedia in their learning process. As technology advances in this ICT era, it has become more feasible to integrate multimedia directly into the classroom teaching and learning process. Pupils in most schools were seldom taught the computer knowledge and computer skills due to the constraints of classroom time. Hence, the pupils became less enthusiastic to integrate multimedia into their learning. Most of them were not aware of the importance of integrating multimedia into their learning as they were contented and comfortable employing the conventional ways of learning. Therefore a classroom investigation was deemed most appropriate to engage these primary pupils in computational thinking using multimedia based on Scratch Programming. It is hoped that this classroom investigation would be able to enlighten pupils and teachers on the importance of integrating multimedia presentation and ICT as an approach for teaching and learning.

### *Integration of ASSURE Model in teaching and learning activities*

The ASSURE model Instructional System Design (ISD) below (Fig.1) was used in designing the instruction for this multimedia topic. ASSURE model was developed by Heinich, R., Molenda, M., Russell, J. D., & Smaldino, S. E. (2001) and it became one of most appropriate model of learning environment to be used. The practice of this instructional design process can help to ensure heightened students' interest in the lesson taught; make certain that the teaching and learning process is cost effective and able to verify that the learning content matches the intended objectives for classroom investigation.



Figure 1. ASSURE Model Instructional System Design (ISD).

### *Element of computational thinking*

Computational Thinking (CT) is the thought process involved in formulating a problem and expressing its solution(s) in such a way that a computer or machine can effectively carry out. CT is essential to the development of computer applications, but it can also be used to support problem solving across all disciplines, including the humanities, math and science. (Jeannette, 2006).

Generally, computational thinking involves six different concepts and five approaches to working. Firstly, *Logic* involves predicting & analysing; secondly is *Algorithms* which is making steps and rules; thirdly, *Decomposition* which is the breaking down into parts; fourthly, the *Patterns* in which the process of spotting and using of similarities are identified; the fifth concept is *Abstraction* which involves the removing of unnecessary details and finally, *Evaluation* occurs in which the process of making judgement is conducted.

The five approaches of computational thinking include *Tinkering* (experimenting & playing), *Creating* (designing & making), *Debugging* (finding & fixing errors), *Persevering* (keeping and going) and finally, *Collaborating* (working together). In this research, element of algorithm and decomposition have been integrated in scratch programming in order to teach multimedia element. A movie about A Trip To The Zoo using scratch programming has been shown to pupils. Teacher asked pupils to identify element of multimedia found in the movie. The breaking down of multimedia element allow pupils to understand concept of decomposition. Pupils have to list all the multimedia element. The pupils will then be asked to prepare their own presentation using Ms Power Point. The step by step rule of algorithm has been used in creating multimedia presentation. Teacher guided pupils how to create content in the Ms Power Point slide. Pupils were asked to plan text, audio, video and graphic that they will put the presentation.

## METHODOLOGY

This study employed a quantitative study method to collect data. The data collection procedure was initiated by the discussion with the class teacher to get some information about students present understanding about multimedia.

### ***Participants***

The researchers conducted purposive sampling in a school in Ampang, Selangor, Malaysia. The participants of this study consist of 23 boys and 13 girls primary school pupils from 4 Bestari class. Majority of the pupils are from the medium social class.

### ***Instrumentation***

Research instrument consisted of five questions focusing on element of multimedia provided in presentation. Questionnaire was measured using five likert scale 1- strongly disagree, 2 - Disagree, 3 - indifference, 4- Agree and 5 - strongly agree. Data was analyzed using Statistical Packages for Social Science 23.0 (SPSS) software. Semi structured Interviews protocol were conducted with five students.

### ***Data analysis***

Data was analyzed using the Statistical Packages for Social Science 23.0 (SPSS) software and qualitative data from the interview were sorted out thematically.

### ***Implementation of classroom investigation using ASSURE MODEL***

The researchers made a pre visit to the school on the 20th of July 2016. A short discussion was held with the School Assistant Head and the Year 4 ICT subject teachers at the school office. The researchers explained the aim of the intended classroom investigation and the administrators of the school agreed to the researchers' request. The implementation of classroom instruction was based on ASSURE model.

Firstly, for *A – Analyze Learner*, the first step is to analyze learner. The researchers gathered the information from the ICT teacher with regards to the characters, differences in academic abilities and learning styles of the year 4B pupils. The learner background such age stage, interest and background were identified. The duration of the classroom investigation was an hour.

Secondly, *S – State Objectives*, this refers to knowing the intended outcomes or expectations, which were identified and stated explicitly. To be more concrete about things, this statement focus on for example learner will be able to identify and name the elements of multimedia.

Next *S – Select Strategies, Technology, Media, and Materials*. Two presentations were developed by the researchers, for pupils' interactive activities; one using presentation slides and the other one is using Scratch Programming in which an animation story entitled "A Trip to the Zoo" and video were utilized. Group discussions or cooperative group work were done in the later strategy.

The multimedia presentation was developed using Scratch programming. The project presentation was enhanced the elements of multimedia which consists of texts, images/graphics, audio, video and animation. A simple short story of "A Trip to The Zoo" was developed. The project topic was planned according to the pupils understanding about a science subject of animal classification. A few cartoon characters were added in the scene with conversation about visiting the zoo and describing the animal classification. The backdrop was changed according to the scene to provide variety and to make it more interesting.

The following step was *U – Utilize Technology, Media, and Materials*, whereby the pupils were engaged in the hands-on tasks of using the technology, the media and materials provided.

Next step was *R – Require Learner Participation*. At this stage, all the materials provided were well prepared for learner participation because the materials are user-friendly and easily applicable for the

tasks required. Pupils played their main roles for all the activities given, most importantly, the pupils were actively engaged in Computational Thinking process concurrently. The task given encouraged active participation as this was supposed to be student centered learning.

The final step was *E – Evaluate and Revise*. At this final stage, evaluation of the impact of the classroom investigation was conducted using worksheets and open ended questions. The data collected was focussed on the aims of the study in order to enable the researchers to answer the stated objectives of the study. The unplugged activity sheets were prepared and evaluation instruments were developed. A simple (yes/no answer) survey procedure and open ended questions were drafted and used immediately. The simple survey will encourage and motivate the pupils to participate with ease and is not threatening.

## FINDINGS

The findings of this study were focussed specifically on the two main aims which were, firstly, to determine pupils’ understanding of the multimedia elements; and secondly to find out to what extent the pupils are engaged in computational thinking in the learning process.

### *To determine pupils’ understanding of the multimedia elements*

Analysis of the pupils’ responses indicated that they were able to identify the elements of multimedia, function of multimedia and the file format of the elements used in the Scratch Programming. In order to determine pupils’ understanding of the multimedia elements, students were engaged in computational thinking and were instructed to find the elements of multimedia and its function in the multimedia presentation provided. The procedure includes the three steps as follows:

- i. Identifying the elements of multimedia in the presentation.
- ii. Stating the function of each type of elements of the multimedia in the presentation.
- iii. Classifying the file format for each type of elements of multimedia used in the presentation.

The list of survey questions was used to evaluate the understanding of the multimedia elements from the Scratch animation presentation of “A Trip to the Zoo”. This animated presentation was used as an example of multimedia project to introduce the elements of multimedia to the pupils. The five main questions were specifically focused to the elements of multimedia. From the analysis of the data collected from the questionnaire, it indicated that all the pupils knew that in every multimedia there must be elements of multimedia.

Table 1

### *Item to evaluate multimedia presentation in identifying multimedia elements*

No.	Elements	Percentage of Agree (%)
1.	I can identify the audio element used in the conversation	82.5
2.	I like to look at the pictures in the presentation	89.0
3.	I am able to read the text in the presentation	78.0
4.	I can identify the visual element used in the conversation	74.0
5.	I can answer the interactive quiz questions	98.0

With reference to Table 1, 82.5% are able to hear the sound of conversation in the multimedia, 89% of them like to see cartoon characters as they made the presentation alive, 78% are able to read the text and hear the

conversation simultaneously, and 74% agreed that the text is clear and they can identify the content too. Finally 98% of the pupils are able to answer the interactive quiz questions successfully and expressed that they enjoyed the interactive quiz too. In conclusion, this findings indicated that the pupils were able to identify the multimedia presentation; they are able to understand the elements in all multimedia project because elements of multimedia were most important to make the presentation colourful, interactive, lively and interesting.

Additionally, it was found that a wide range of multimedia elements were used in the multimedia presentation. These elements maximised learners’ engagement. Hence, it is suggested that we need to opt for a variety of forms of multimedia elements when choosing the perfect multimedia components for any eLearning course. This will also allow us to cater to the different learning needs of our pupils. For example, learners who are auditory will benefit from audio elements, such as recorded lectures or music, while those who tend to learn more from visual components might prefer interactive games or videos. However, teachers are reminded not to go overboard when selecting your multimedia. Pappas (2014) suggested too, that we need to keep in mind that the multimedia we use should accentuate our core content and improve learners’ retention.

***To find out to what extent the pupils are engaged in computational thinking in the learning process.***

The ICT activity using slides was employed to stimulate pupils’ interest and to engage them actively during the lesson. It was found that the pupils were able to list a few gadgets used to capture pictures/images, recording audio and video. When the ‘decomposing process’ is being applied for this activity, pupils felt excited to write the answer one after another using the provided slides. By applying algorithm dan decompose concepts and skills in the activity, the pupils managed to develop the storyboard in a proper and logic sequence. They were observed to be discussing and collaborating with each other in the process of designing the storyboard. They tried to complete the task quickly because the time given was limited.

After the pupils have experienced developing the storyboard step by step, they shared their opinion on the development of the storyboard. Some of the excerpts from the interview conducted were recorded and presented as follows:

Table 2

*Student responses and intepretation*

<b>Student</b>	<b>Responses</b>	<b>Interpretation</b>
<b>A</b>	<i>“... I could have nice multimedia presentation.”</i>	Positive. Learning multimedia using scratch programming were very encouraging to create nice multimedia presentation. Pupils became more motivated.
<b>B</b>	<i>“... I am able to produce interesting sound of animals.”</i>	Positive. Using Scratch Programming is easy to produce the sounds wanted and to set the timing of animals sound.

C	<i>“... I can have many pictures of animals in the multimedia presentation.”</i>	Positive. Scratch Programming has a variety of animal pictures and characters to choose from hence its easy to animate them.
D	<i>“... colourful! I like the multimedia presentation which is very colourful.”</i>	Positive. There are a variety of colors to choose from the Scratch Programming software for a colourful presentation.
E	<i>“... yes, I can give names to each of the animals that I insert.”</i>	Positive. All the characters involved in the scene can be named easily.

The responses from the interviews indicated that the pupils have clear understanding of the whole process of developing the storyboard. The pupils were not only applying the algorithm, they were following the steps of the activity which was systematically arranged. They were required to follow the completed storyboard step by step so that they are able to create a multimedia project in the next lesson. The elements of multimedia, text, pictures/images, audio and animation which were planned earlier were inserted into the multimedia project. Creativity were enhanced and innovative ideas were enriched when the pupils were designing and discussing in groups. The achievement of the pupils was proven from the design of their brainstorming idea in the group of developing the storyboard.

From the observations conducted by the researchers, the pupils were engaged and became “... enthusiastic users of the tool, and did not struggle in the time we spent with them (for the most part) to stay on task or stay interested in their own game development.” as described by Jenson & Droumeva (2016). The observations conducted also shows that most of the pupils are able to name the elements of multimedia and they indicated their familiarity with the file format of each of the elements.

### CONCLUSION

Theoretically, there is no reason for teachers not to incorporate multimedia and computational thinking into their classroom teaching. The findings from this study revealed that the computational thinking approach successfully encouraged active participation of the pupils during the activities conducted in the classroom. It was evident that there were many advantages of integrating computational thinking concepts in the ICT teacher’s classroom teaching. Firstly, the pupils were highly motivated to learn when ICT was incorporated into the lesson. In addition, the integration of multimedia elements such as video, animation, graphic, text and audio enhance the lessons drastically. The student-centred activities which were interactive appealed to the pupils, hence setting the most conducive atmosphere for learning.

Simultaneously, the integration of multimedia captivated the pupils’ attention and they put more effort in comprehending the tasks to be completed. In the process, the pupils are able to retain the information better because the integration of multimedia was able to activate and stimulate the memory process. The multimedia activities were non threatening, hence reduced the anxiety level among the pupils. Therefore, most of the pupils were able to answer the exercises given correctly and easily. This has proven



that the integration of multimedia and the use of ICT in classroom teaching aids understanding of a lesson and is most beneficial for the pupils and teachers.

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