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Preliminary Study in Emerging Competence Domain: Synergised Computational Thinking (CT) Skills and Brain-Based Learning (BBL) in TVET Curriculums

Wan Nor Ashiqin Wan Ali*

Pusat Pengajian Pembangunan Insan & Teknokomunikasi (iKOM), Universiti Malaysia Perlis.

ABSTRACT

Recently, Malaysia's higher education curriculum in Technical and Vocational Education and Training (TVET) has become popular especially in the education sector. There are strong relationships between government, industries and educational institutions in addressing and tackling the country's skills challenges among university graduates to achieve Malaysia's mission for high-income status by 2020. According to recent studies, the stakeholders failed to fulfil the job vacancies in their industries due to the lack of skilled university graduates, even though they are from the TVET institutions. The 11th Malaysia Plan foresees the increment of job vacancies that require the TVET-related skills in 2016 – 2020, however, some institutions are not able to produce graduates with TVET-related skills that met the industry demand. This study shows that most of the existing industries are directly or indirectly related to Information and Communication Technology (ICT) which are the third-largest economic catalyst in Malaysia. Based on the study conducted by National ICT Association of Malaysia (Pikom), 10% of new employees in ICT sectors are successfully accepted by the industries while the remaining 90% requires additional or extensive training before they are ready to work in the industries. These conditions happen due to the University's failure in producing graduates with TVET-related skills that can support the rapid evolvement of ICT sectors.

Keywords: CT Skills, Brain-Based Learning (BBL), Soft Skills, TVET.

1. INTRODUCTION

According to the previous studies, several Malaysian graduate's skills challenges were identified which are a lack of relevant skills training, problem-solving skills, outdated curriculum and poor soft skills, specifically with regard to the deterioration in English proficiency. Hence, this study highlights the importance of having the Computational Thinking (CT) skills in Technical and Vocational Education and Training (TVET) curriculums. CT skills can be described as a set of thinking and problem-solving skills needed as a basic requirement for the graduate in all areas before entering the working phase.

In realising Malaysia's vision 2020, the quality and skills of human resources are the most vital factors that contribute to economic transformation. The study conducted by Economic Planning Unit (EPU) shows the increment of job vacancies in the TVET sector due to the introduction of the National Key Economic Area (NKEA) [1]. The Human Resources Minister Datuk Seri Richard Riot Jaem stated that TVET graduates faced challenges because there is no uniformity in TVET curriculums [2]. Moreover, the highlighted TVET challenges are in line with Prime Minister Datuk Seri Najib Razak's announcement during the tabling of Budget 2018. However, most of the TVET graduates still need to go through a series of training before officially being employed. Industries identified that TVET graduates are lack of problem-solving skills, soft skills and low

* Corresponding Author: *ashiqinali@unimap.edu.my*

in English proficiency. This study recognises that there must be continuous initiatives to improve the TVET curriculums, thus greater TVET graduates can be produced. This study aims to integrate the Computational Thinking (CT) skills into TVET curriculums to tackle the TVET graduates' challenges.

2. LITERATURE REVIEWS

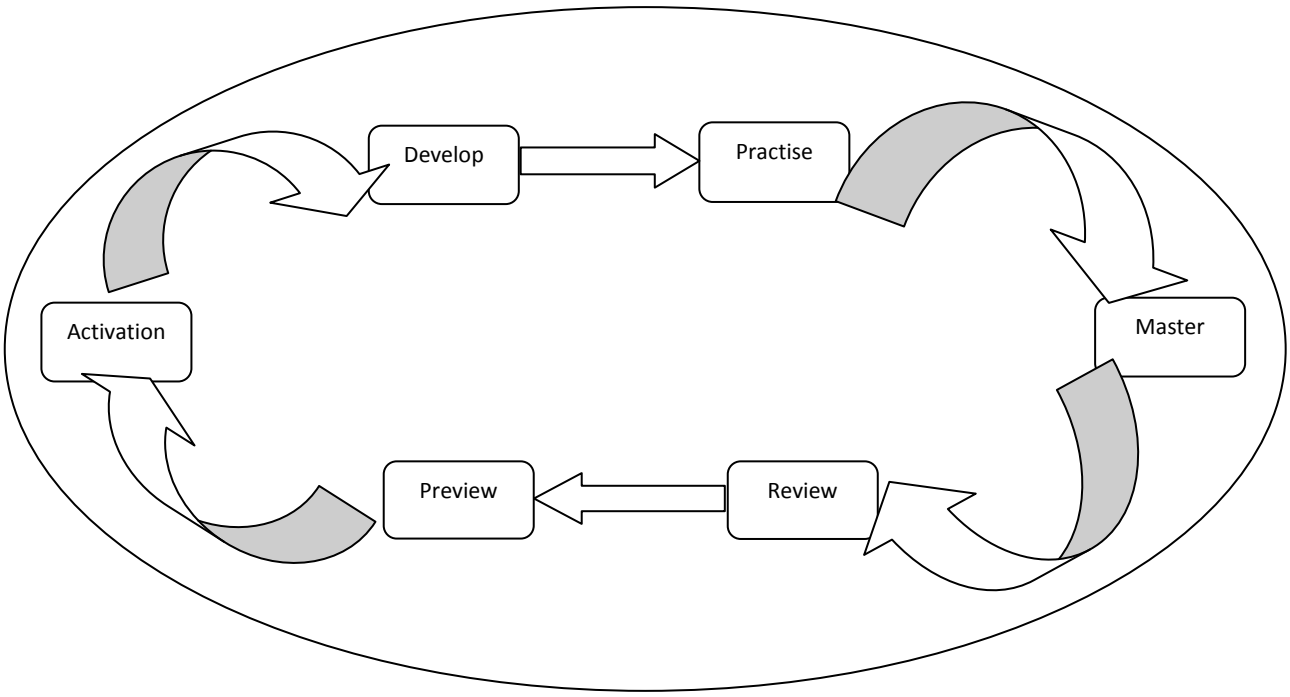
Malaysia is crucially requiring highly-skilled manpower to adjacent the current demand-supply gap in various industries, predominantly those driving economic revolution. The government foresees TVET sectors as the key track to provide the highly-skilled manpower in achieving Malaysia's Vision 2020, to become the high-income nation [1][3][4].

The synergy of integrating the TVET sectors with the emergence of technology leads to dramatic economic and social impacts. These issues created job opportunities as well as the challenges and numerous uncertainties. The highly-skilled manpower has created a huge gap between the average and low-skilled, hence generate income inequalities. The changes in income inequalities trigger the opportunities in TVET sectors as well as created new opportunities for change and innovation. However, most of the TVET graduates are lacking problem-solving and soft skills, as well as low in English proficiency. In this technology era, economic evolution depends on brainpower rather than strength and value is formed based on the skills, experiences and continuous learning. The ICTs can play a vital part in reducing the education level gap between the employees and generates a lifelong learning culture in TVET. Nevertheless, there are several obstacles that obstruct the ICTs practice in teaching and learning for TVET institutions. The utmost obstacles are the infrastructure, accessibility of proper resources, and reliability of curriculums' content [5].

The Malaysian Curriculum Development Centre has acknowledged that the conventional lecturing approach failed to create creative and innovative minds to the students. Students failed to link the relationship between old knowledge (information that they already had) with the new knowledge they learn in the real-life situation [6].

Brain-Based Learning (BBL) approach is one of the learning methods which have proper lecturing phases that can be applied by the lecturers using appropriate and significant real-life difficulties as its basis. Literature has indicated the strengths of BBL in terms of active learning which focusing on 100 percent student involvement. The students' involvement can be created by applying the Inquiry-Based Learning (IBL) approach.

IBL approach is crucial for an educator besides the typical teaching and learning qualified knowledge. Lecturers are required to increase the specialised knowledge related to the teaching methods in order to keep track with the emergence of technology. They are required to be able to apply the theoretical and practical application in expanding the existing knowledge as well as the new one [7]. The TVET lecturers need to acquire various specialisms, involve in high-level of thinking and contribute to dynamic learning practices. As the knowledge evolves rapidly in line with the emergence of technology, lecturers need to manage the existing knowledge and endlessly improve and develop a new knowledge. Hence, the CT skills are really crucial to be adapted in TVET teaching modules to enhance the teaching and learning practises. Figure 1 shows the overall structure of the CT skills. Studies prove that by adopting the CT skills, students who were provided chances for unstructured study cases or samples established greater performance compare to students accomplishing traditional tasks or project-oriented exercises.



CT Skills

Inquiry-Based Learning (IBL)

Types	Ask question	Guidelines	Who find the solution
Structured	Lecturer	Lecturer	Student
Guided	Lecturer	Student	Student
Open	Student	Student	Student

Figure 1. The structure of computational thinking (ct) skills.

3. COMPUTATIONAL THINKING (CT) SKILLS TRAINING SIMULATION VIA CLASSROOM INVESTIGATION

The classroom investigation is conducted to practise the knowledge and experiences gathered from MDEC CT-CS training. Four lecturers have been selected to take part in this classroom investigation. Those lecturers are from a different background of studies. Two of them have some basic programming languages and the others do not have any background of computer sciences. The information is gathered from the pre-survey before the classroom investigation is conducted. Most of them willing to join the class because they want to learn about CT skills and Scratch (referred to Appendix 1). They aim to adapt those CT concepts in their Teaching and Learning (T&L).

The classroom investigation was started with a basic lecture to expose the participants about the BBL, IBL and CT skills. Then, some activities were conducted to identify their problem-solving skills. The trainer asked a few questions to the participants and observes their ability to solve that problems and their justification.

Next session was conducted to teach the participants how to use Scratch as a beginner. They have been exposed to the importance of CT concepts in T&L and how they can use Scratch to develop and polish their problem-solving skills.

The trainer introduces the basic of Scratch to the participants as follows:

i. How to control and use the Scratch (Scratch interfaces, start, debug, blocks, Sprite etc.)
ii. How to make the Sprite walk, talk, change costume, show and hide, animation etc.
iii. The participants have been exposed with both versions of Scratch (version 1.4 and version 2.0).

Then, participants were asked to complete a task related to the Metamorphosis cycle. The trainer gives freedom to the participants to come out with their own ideas on how they want to deliver their project on Metamorphosis cycle. Those ideas need to be sketched and submit to the trainer before they can proceed with the programming on Scratch. This is because the trainer wants to observe whether they can apply the CT skills in their tasks or not. Table 1 shows the summary of classroom investigation which based on BBL approach.

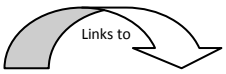
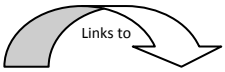


Table 1 The classroom investigation using brain-based learning (BBL)



OLD KNOWLEDGE		**NEW KNOWLEDGE**				**FUTURE KNOWLEDGE**
PHASE	**ACTIVATION**	**DEVELOP**	**PRACTISE**	**MASTER**	**REVIEW**	**PREVIEW**
Description for each phase	Prior knowledge of the student	• Express objective (two objectives maximum for each session) • Let the student format the knowledge themselves • Link and organise the knowledge • Develop a new knowledge (lecturer can adapt the IBL approach)	• Learn by doing • Lecturer and students have the opportunity to give feedback • A good feedback can be expressed by (1. Looking for the patterns; 2. Make sure the feedback you give is the highest priority; 3. Giving balanced feedback; 4. Designing the feedback opportunity) • The	• Students are able to create their own solution by themselves without any instructions given by the lecturers	• Summarise the lesson with student involvement	• Preview the next lesson to the students (most effectively express it like a movie trailer)

			lecturer can adapt the IBL approach			
Actual progress of classroom investigation	The online survey (pre-survey) has been conducted to identify whether the participant has prior knowledge of programming languages or not.	Objectives: • To educate and share knowledge of BBL, IBL and CT skills with lecturers. • To expose the use of Scratch to the lecturers in T&L.	• Giving an assignment to the lecturer regarding "metamorphosis cycle". • They need to conduct their assignment based on the BBL approach and explain how they adapt the CT concepts in their tasks.	• None	• In this phase, they will demo their Scratch project to others by adopting some relevant CT concepts. • The other lecturers will give feedback on their teaching demonstration and do some discussions to improve their project or presentation.	• None

When the next session is finished, participants are required to sketch the ideas on Metamorphosis cycle for their Scratch project. The participants sketched their ideas in a storyboard approach where they imagined how they can convert their idea on Metamorphosis cycle. They need to extract what is important first (abstraction) before they can proceed to sketch their ideas. Some examples of the storyboard sketched by participants are shown in Figure 2 until Figure 4.

4. STORYBOARD (ABSTRACTION, DECOMPOSE)

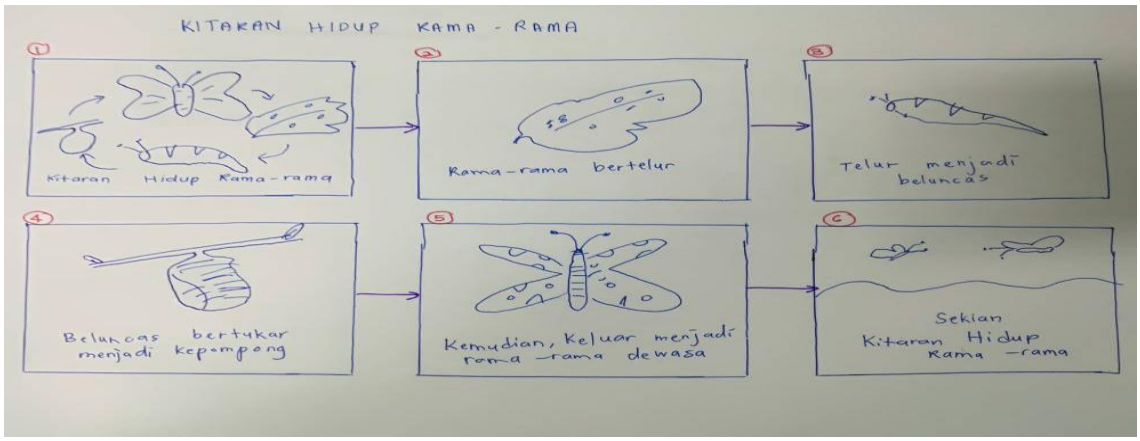


Figure 2. First example of the storyboard.

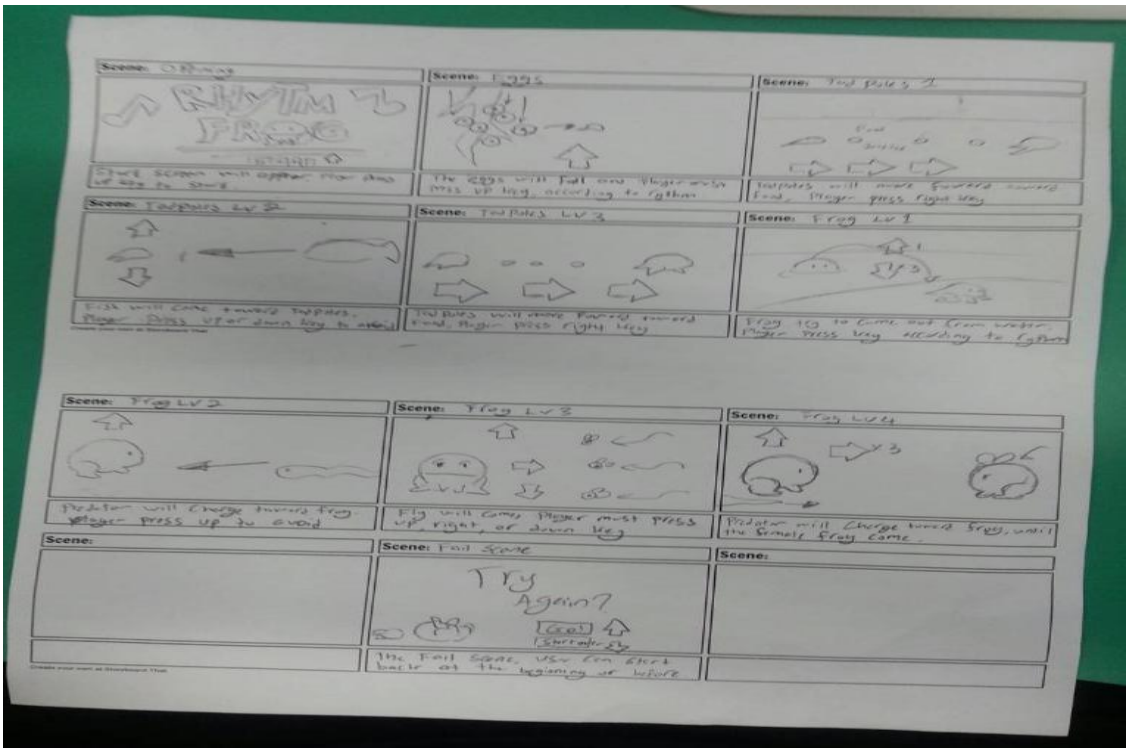


Figure 3. Second Example of the Storyboard.

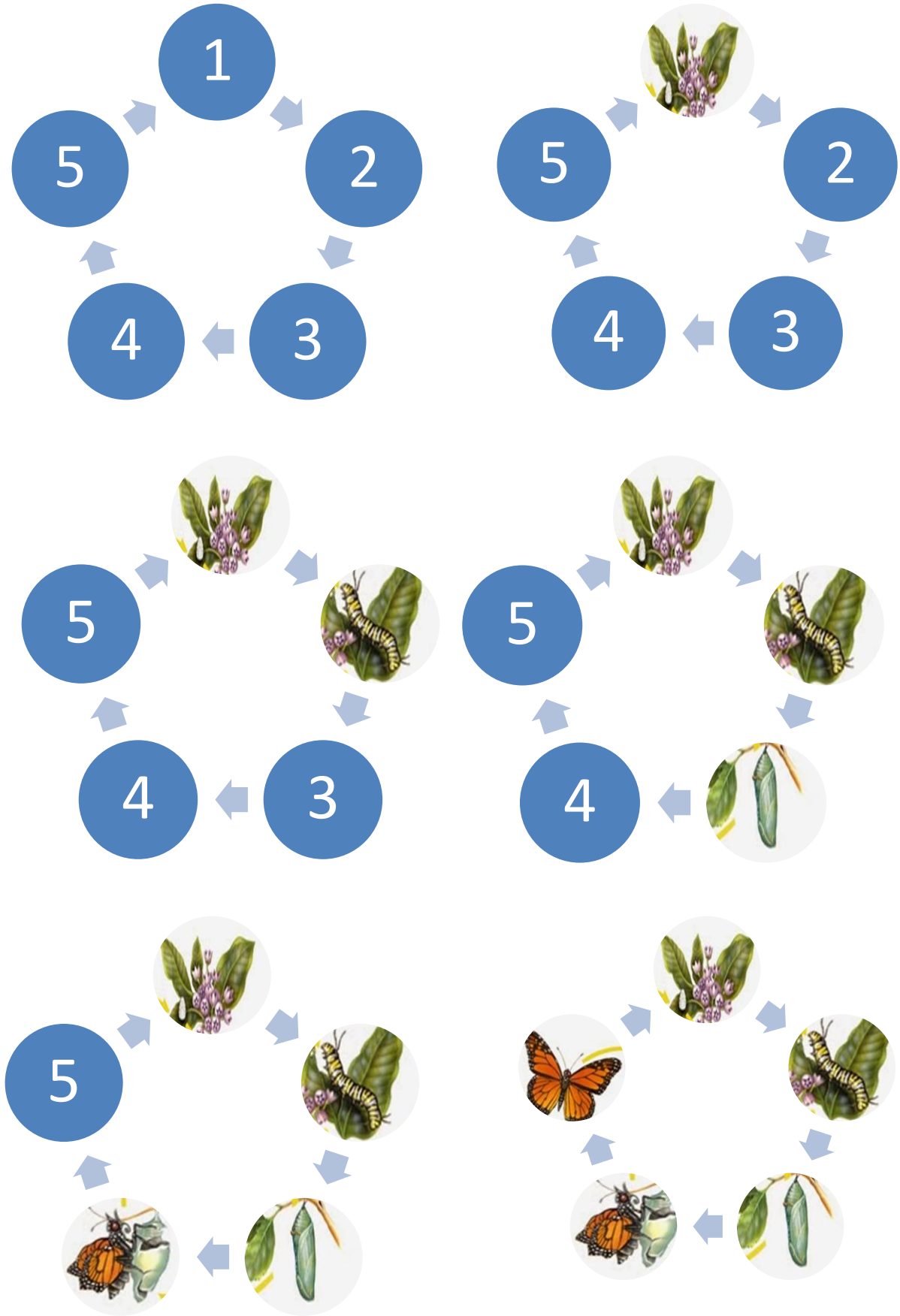
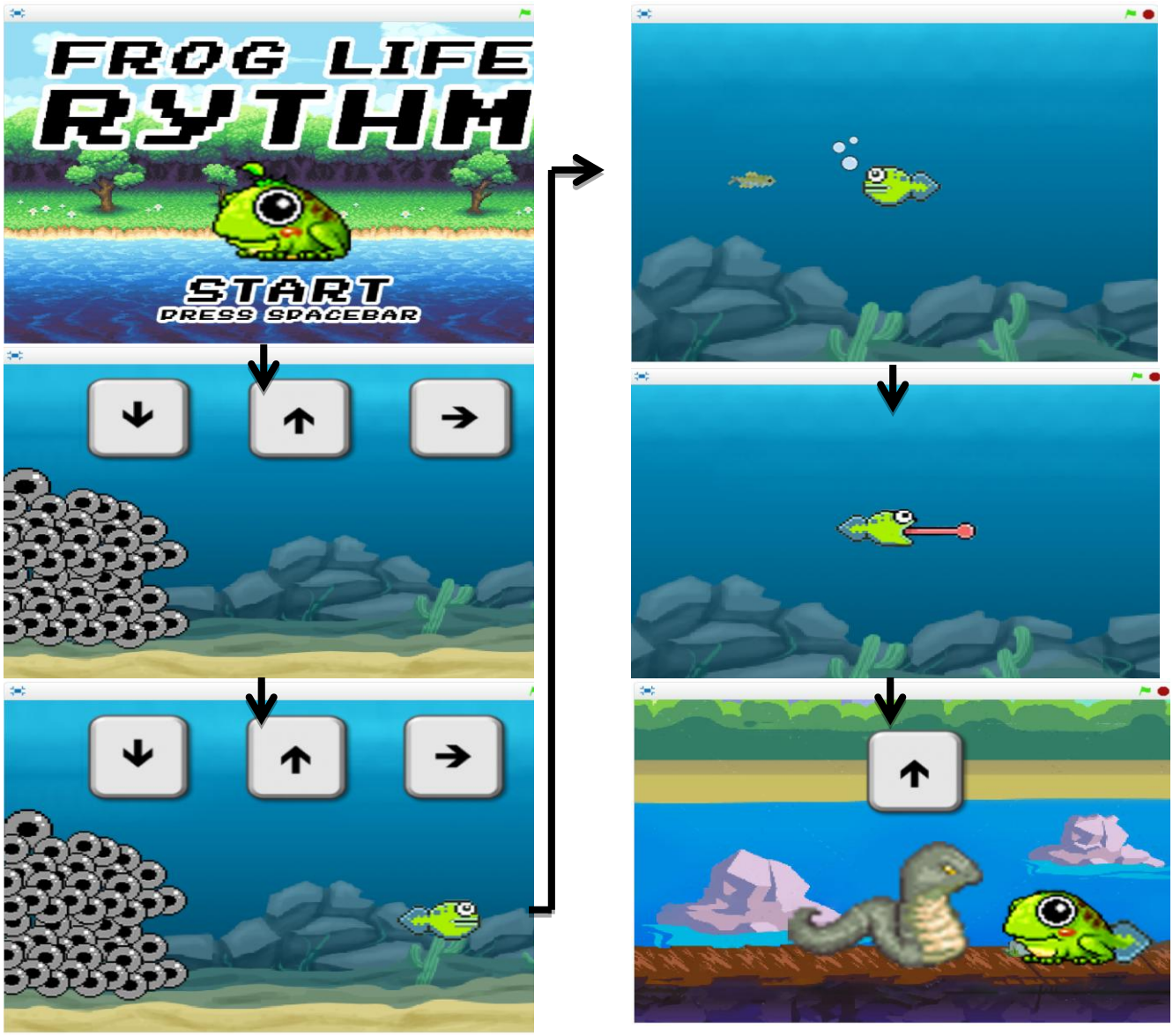


Figure 4. Third Example of the Storyboard.

Once the participants finished sketching their ideas, they will proceed with the Scratch programming. The trainer has to observed participants' ability to transform their ideas from storyboard to Scratch. In the beginning, some of the participants still have problems to handle the Scratch but they are getting more and more competent as they start to learn from their mistakes. The trainer does not provide too much guidance to the participants because she wants them to get the "CT concepts- pattern & logical reasoning". The trainer will be asked the participants in return if they asked a solution from her because she wants them to develop their CT skills before they can apply to their students. The next CT skills that they obtained is the algorithm; which is obtained by doing the programming using Scratch. Figure 5 shows one of the programs developed by the participant within a short period of training. However, they are some bugs occurred in this Scratch project. The trainer will conduct next informal training sessions to get them to identify the bugs in their own projects. The next informal training sessions are purposely conducted to get the participants to know how they can identify the bugs in their program and fix them.



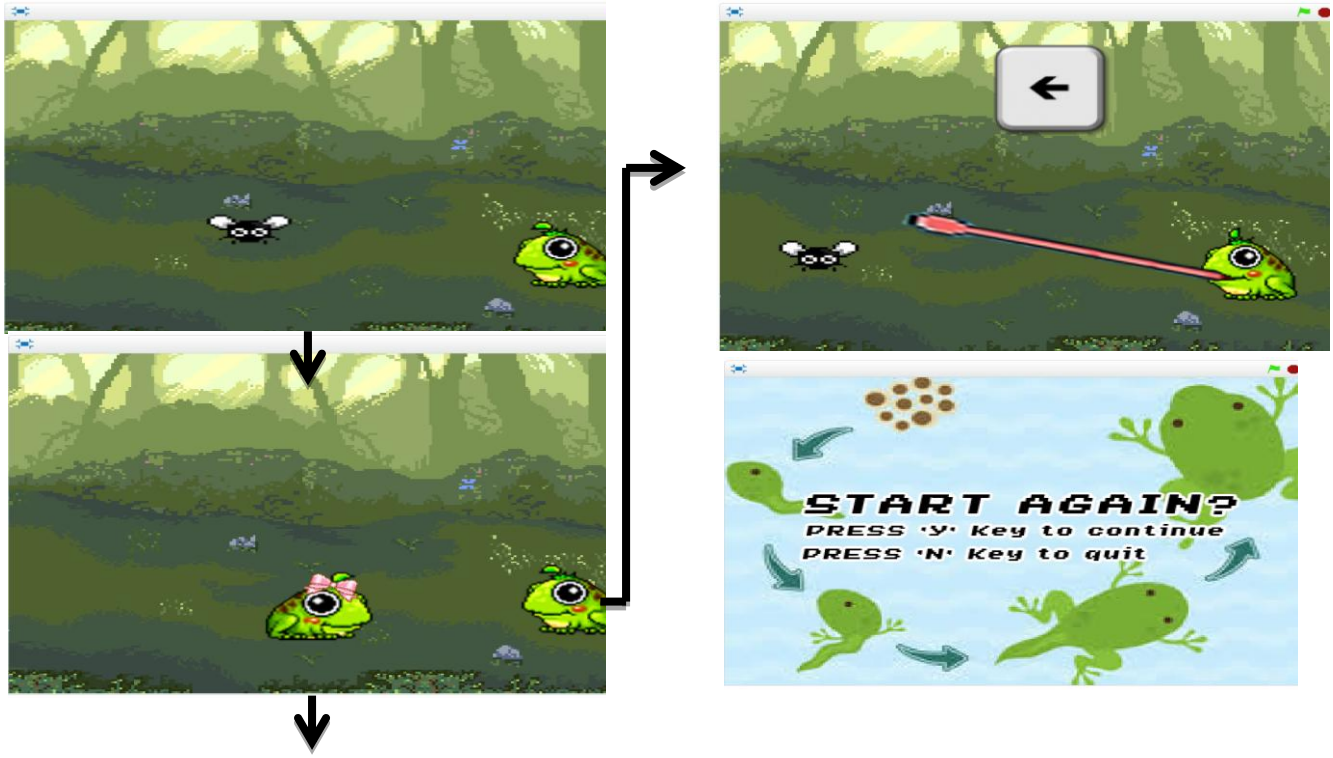


Figure 5. Example metamorphosis cycle project using scratch.

5. CONCLUSION

Malaysia is evolving rapidly with the high demand for technical and engineering manpower. Those demands keep increasing by years which need to be crucially accommodated by TVET institutions. However, most of the TVET graduates failed to fulfil the industry demands because they lacked problem-solving and soft skills. Therefore, in order to meet the needs of this manpower, the government has priorities the TVET issues. Presently, Malaysia has the technical and engineering manpower of about 12 million, of which only about 28 percent are highly-skilled, whilst 60 percent are employed in small and medium-sized enterprises. Those 60 percent has been identified as an employee who has a lack of problem-solving and soft skills. These issues can be tackled by introducing the CT skills in TVET curriculums. Coherence with this issue, the government can produce a pool of skilled workers that can manage various types of work and well-prepared for the rapidly changing world of work. The worldwide emergences in technology and particularly in the Malaysian industries have formed a high demand for skilled manpower and comprehensive training.

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