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Enhancing Students' Motivation to Learn Computational Thinking through Mobile Application Development Module (M-CT)

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Abstract: ***In the 21st century, making daily innovations in software and hardware to facilitate the life process is the daily task of the community. This innovation also goes beyond the education field, various interventions were introduced by integrating technology to enhance the understanding and motivating of students in a subject. In view of this, we brought modernization into the learning of Computational Thinking (CT) in the form of a module that integrates mobile application development for the motivation of students in CT. In this module, students are taught to develop mobile applications using a visual programming language. This approach can be a catalyst for enhancing the motivation of students of the digital generation and the efficiency of learning. In motivation measurement, we used the Motivated Strategies for Learning Questionnaire (MSLQ), which consists of five domains of motivation, namely Intrinsic Goal, Extrinsic Goal, Task Value, Learning Beliefs Control and Self- Efficacy. This is divided into two groups, namely conventional and mobile applications for control and treatment groups. In treatment group consisted of 46 (51%) and the control group consisted of 45 (49%) respondents. All respondents of this study are students, studying in Institute A that offers similar courses which are Bachelor of Business Administration degree in collaboration with two different universities (University A and University B).***

Index Terms: ***Computational Thinking (CT), Mobile Application Development through CT skills Module(M-CT) and Motivated Strategies for Learning Questionnaire (MSLQ)***

I. INTRODUCTION

From the moment a country has become independent, its education system has constantly undergone reforms, which are endorsed by the Ministry of Education or Ministry of Higher Education in most of these countries. The ministries recognise that by improving the education system in line with current needs, it will also improve quality and productivity in their countries. With this, higher education institutions play an important role in producing graduates who possess the skills required by the nation and which can meet the needs of employers [1]. In the 21st century, students should be creative, have critical thinking skills, and excellent interpersonal and social relations skills[2]–[5]. Hence, various efforts have been undertaken to enhance the skills available in a student to transform societies into skilled and tech-savvy societies.

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One of these efforts is integrating Computational Thinking (CT) into the curriculum [6]. CT is an effort to develop and enhance problem-solving skills in order to create critical and creative students. The CT concept, introduced in 1980 by Seymour Papert, was to develop the cognitive ability to solve problems through programming [7], [8]. In 2006, Wing expanded the CT concept and stated that it was a basic skill and almost suitable for all [9]. Initially, [9] CT involved computer science in the basic concepts of problem solving, system design and understanding of human behaviour. Wing also pointed out that CT is not a computer or machine which will create a solution, but that we can think of the process as within the devices and to provide solutions. This process was generated by the computer scientist, who stated that almost everyone can think like a computer scientist and apply CT concepts in any situations to easily solve a problem. Students with this skill can solve problems and contribute ideas in the development of new world technologies [10]. In addition, CT provides an opportunity for individuals to enhance their knowledge, skills, standards of living and become successful people in society. Furthermore, for the successful implementation of CT, and also the transformation of education, requires strategies, approaches and new methods of teaching and learning that enables students to acquire and fully utilize CT skills. It is also supported by [11], [12] who state that strategies, approaches, and methods of teaching and learning need to be emphasized and taken seriously in order to achieve a desire in a newly introduced educational concept to produce students with knowledge, skills, creativity in thinking and innovativeness to face the challenges of the present and future. Consequently, teaching aids play an important and direct role in cultivating new concepts to improve understanding, achievement and motivation in the process of teaching and learning among students [13]. They suggest further that the most effective teaching resources often used to help instructors channel knowledge and skills in students are modules. In addition, the design-based learning approach is one way to effectively help students understand a concept , but it also helps to build new ideas and enhance skills if students are involved in producing artefacts[14]. This view is also supported by [15] who suggests that this approach can also maintain student interest, improve achievement, enhance 21st century skills, motivate and further develop curiosity. As a result, for this study we have used the design-based learning approach to develop a mobile application development module to enhance student's motivation to learn Computational Thinking.

II. MOBILE APPLICATION DEVELOPMENT THROUGH CT SKILLS MODULE (M-CT)

The mobile application development module for enhancing Computational Thinking (M-CT) aims to help students learn and motivate themselves about Computational Thinking (CT), how computer science materializes these thinking skills and how it can be integrated into a variety of subject areas.

It increases students' awareness of CT, allows students to explore examples of CT that can be integrated into their daily routine tasks, experiment with examples of CT-integrated activities for their subject areas, create a plan to integrate CT to solve problems and enhance the motivation of CT skills.

It also emphasizes problem solving that utilizes students' prior knowledge in their subject area together with computational thinking skills to help them understand the nature and scope of a problem. The module also equips students with hands-on experience to ensure that the CT skills can be effectively delivered and transferred to them. For hands-on purposes, this module integrated mobile application development and the platform used is App Inventor. App Inventor is an intuitive, visual programming environment that allows everyone to build fully functional apps for smartphones and tablets. App Inventor uses blocks-based tools that allows anyone to programme more complex, impactful mobile apps without prior language skills [16]. The App Inventor project seeks to democratize software development by empowering all people, especially young people, to make the transition from being consumers of technology to becoming creators of it[17].

Today, mobile technology has become a visible part of students' lifestyles. The development and advancement of mobile technology in education has grown rapidly without one realizing it. The development of the world in mobile technology has had a huge impact on the life of a student. Additionally, App Inventor is typical for students wishing to learn Android Application. App Inventor is easy because it uses a visual programming language. In addition, there are five activities in this module, including unplugged activities, as shown in Table 1.

Table 1: Activity in Mobile Application Development Module

Activity	Summary
Unplugged Activity	This activity introduces learners to computational thinking by way of exploration as a group pertaining to the definition of computational thinking and the elements contained in computational thinking.
Hyperlink App	Apply computational thinking skills elements to develop a mobile application that shows links to a search engine (Google, Yahoo, Ask and Bing).
Text_Reader App	Modify the 'Text_Reader' application with the features described below: 1. Clear the text after reading 2. If not insert the text into the textbox, 'Text_Reader' app should alert the user to insert the text 3. Edit the elements of computational thinking before developing the app
Radio App	Design Radio application with the features described below: 1. Design Flow Chart based on Pseudocode 2. Create the 'Radio' app based on elements of computational thinking 3. Display the output in Android Phone
Project	The purpose of this activity is to encourage learners to learn in-depth computational thinking skills. In this activity, the student is required to discuss with the group members and develop a new mobile application (if any). In addition, they need to integrate elements in CT such as Abstraction, Algorithm, Decomposition, Pattern Recognition and Evaluation in the MADLC model. This process needs to be presented to the instructor before developing a mobile application.

III. MOTIVATED STRATEGIES FOR LEARNING QUESTIONNAIRE (MSLQ)

Motivation is an important factor in the teaching and learning process. A literature review on motivation in learning has shown that motivation plays an important role in influencing the teaching and learning process [18]. Motivation is believed to stimulate individual learning. The study was conducted by [19], who views CT learning as a learning tool which is relevant in the teaching and learning process. In addition, according to [20], students' motivation is generally increased when students are actively involved and given full responsibility in the learning process. In the study by [21] it is found that mobile app developers through app inventors in the teaching and learning process of CT can improve the domains of motivation among students. The learning process, by using the design-based learning concept, provides students with a small group of responsibilities and experience to solve a problem as one of the important factors in improving student motivation. In addition, [15] states that the implementation of a design-based approach develops the skills of students and enhances student motivation in solving problems. There are studies that have been carried out by [22] that found learning to use a design-based approach to improve student motivation is more effective than conventional learning. The use of technology in CT learning is very appropriate to help students, and at the same time motivate them, to understand the CT elements. The computer simulation can also reduce the misconception of a concept. Using technology in the teaching and learning environment is also said to encourage students to be capable to think critically, solve problems, be more skilled in the process of finding and organizing information and be highly motivated.

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This in turn provides students with the skills required in real life, especially in professional careers [23]. When students have the opportunity to engage in active learning activities they will find that the learning process is more fun and satisfying than passive learning processes [24].

Implementing a less interactive learning process in conventional teaching results in less attention to the teacher when explaining the lesson and shyness in remarking that the student was less motivated and had less understanding of the subject [25]. With this, we used a design-based approach to develop M-CT modules for students who were actively involved and for enhancing their motivation in the teaching and learning process of CT skills. We used five domains through the M-CT module in this study that can evaluate student motivation, in terms of Intrinsic Goal, Extrinsic Goal, Task Value, Control of Learning Beliefs and Self-Efficiency as explained in Table 2. This questionnaire was adapted from the Motivated Strategies for Learning Questionnaire (MSLQ). This MSLQ questionnaire was mainly developed by [26] to evaluate the level of motivation and learning strategies among students. In the study of [21] the MSLQ questionnaire was modified and adapted to evaluate student motivation during a scratch and on an app inventor course. This is in a similar context to this study, so we adapted that questionnaire to evaluate the effectiveness of the M-CT module in terms of motivation for this study.

Table 2: Domains of Motivation

Domains	Explanations
Intrinsic Goal	Intrinsic motivation is known as internal motivation. Intrinsic motivation arises to meet psychological needs. It is also a natural human feature to overcome all the challenges and hurdles in order to get something they want.
Extrinsic goal	Extrinsic Motivation is applicable from external factors. This type of motivation leads to the desire to act caused by external factors
Task Value	A student's confidence will increase over an assignment because the academic task is important to him.
Control of Learning Beliefs	Control of learning beliefs directly affects the level of effort and confidence to succeed in learning.
Self-Efficacy	Higher self-efficacy students have a strong expectation of the ability to succeed in the teaching and learning environment

IV. METHODOLOGY

In the methodology phase, a quasi-experimental design (non-equivalent control) was used in this research because the students are assigned according to their respective sections, and if changes occur it would disrupt the timetables of the lecturers and students. [27] stated that interruptions and problems will occur if researchers formed a new class with a random distribution concept in the study. Consequently, in this study we used the existing classes and process of quasi-experimental design which is shown in Table 3.

Table 3: The design of non-equivalent control group

Group	Pre-Test	Intervention	Post-Test
Control	O_1	Conventional	O_2
Treatment	O_1	M-CT module	O_2

The respondents in the treatment and control groups will sit for pre-test (O_1) before beginning a teaching and learning session on computational thinking topics. Subsequently, respondents in the control group learn computational thinking skills using conventional approaches; the learning materials are slides. The respondents in the treatment group are taught the same topics, but with integrated computational thinking skills into mobile application development. The variables involved in this study are that the study groups use different methods of intervention; the treatment group used the M-CT module and the control group used the conventional method. At the end of the teaching and learning session, a post-test (O_2) will be conducted for both groups.

V. RESULTS AND FINDINGS

In the analysis part, we conducted a study in in Institute A that collaborated with two different universities (University A and University B). University A was involved in the control group and University B was a treatment group. This study involved 91 respondents. The treatment group consisted of 46 (51%) and the control group consisted of 45 (49%) respondents. All respondents of this study are students that studying in Bachelor of Business Administration degree. All of these respondents are living in a hostel that is provided by Institute A. Table 4 showed the percentage of the division between the treatment and the control groups.

Table 4: Number of respondents by group

Group	Number of Respondent	Percentages (%)
Control	45	49
Treatment	46	51
Total	91	100

A. *Homogeneity Test for Students' Motivation on Computational Thinking by Group*

The Questionnaire (MSLQ) on Students' Motivation on Computational Thinking was pre-administered before the onset of the actual study process of 91 respondents. A total of 45 people was in the control group and 46 in the treatment group. M = 1.60 (SD = 0.283) while the mean score of the motivation pre-treatment group was M = 1.69 (SD = 0.266). The mean pre-motivational score of the treatment group exceeds the mean score of the pre-motivated score of the control group of 0.09. Table 5 shows the mean descriptive statistic of pre-motivational score by group.

Table 5: Mean descriptive statistics of pre-motivational scores (overall) by group

Group	Number of Respondents	Mean	Std. Deviation

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Control	45	1.60	.283
Treatment	46	1.69	.266

An overall homogeneity analysis of the control and treatment groups was tested at the significance level of 0.05 to determine whether there was a difference in motivation before actual study was performed.

Table 6 shows the results of the t-test of motivational scores by groups.

Table 6: T-test of motivation by group

Group	Number of Respondents	Mean	Std. Deviation	t	df	Sig
Control	45	1.60	.283	-1.453	89	0.150
Treatment	46	1.69	.266			

The t-test results showed that there was no significant difference between the mean of motivational scores in computational thinking skills for control groups and treatment groups; t = -1.453 and df = 89, p> 0.05. This means that both control and treatment groups are homogeneous in terms of motivation in computational thinking before the intervention was conducted.

B. Students' Motivation on Computational Thinking

Students' Motivation on Computational Thinking was identified through the results of the analysis after intervention on 91 respondents. There was a total of 45 people in the control group and 46 in the treatment group.

1) Descriptive Statistics

Table 7 shows the mean descriptive statistics of motivational scores (post) by group. The number of students involved in the control group was 45 and the treatment group was 46.

Table 7: Mean descriptive statistics of post-group score for motivation

	Group	Mean	Std. Deviation	N
Motivation	Control	4.03	0.20	45
	Treatment	5.26	0.34	46
	Total	4.65	0.68	91

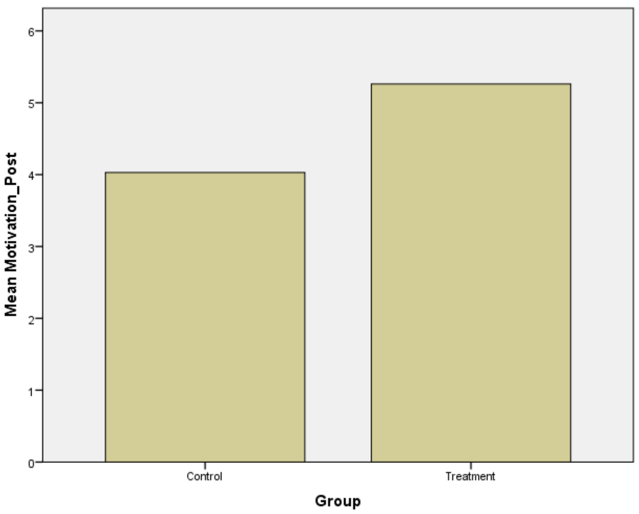

Fig. 1: Bar chart of the mean of post motivational score by group

Fig. 1 shows the bar chart of the mean of post motivational score by group. The post test score means for the treatment group (M = 5.26, SP = .344) are higher than the mean of control test score (M = 4.03, SP = .198). Overall, the mean score of the post treatment of motivation over the motivational score post in control group.

2) Inference statistics

H_{o1}:

There is no significant difference in mean scores in motivation of computational thinking skills between the control and treatment group

The H_{01} hypothesis was tested using t-test of independent samples. Before the t-test was tested, the Levene's test was tested first to determine whether there was a difference in terms of students' motivation after the actual study was performed. Table 8 gives Levene's test results for homogeneity variance for motivation (post).

Table 8: Levene's test for homogeneity variance for Motivation

Dependent Variable	F	df	Sig.
Motivation (Post)	13.075	89	0.001

There was a significant value in the Levene's test for Motivation (Post) is 0.001 ($p \leq 0.05$). This shows that the variance between the control and treatment groups is not equal and the variances not assumed. Table 9 shows the results of t-test of independent samples for the mean score of post achievement by group.

Table 9: Results of t-test for mean score of motivation by group.

Group	Number of Respondent	Mean	Std. Deviation	t	df	Sig
Control	45	4.03	.198	-20.880	89	0.01
Treatment	46	5.26	.344			

Based on the mean score of the post, the treatment group is over the control group. Thus, the H_{01} hypothesis is rejected

because it has a significant difference in mean scores in motivation of computational thinking skills between the control and treatment groups. Furthermore, we tested every domain of motivation with MANOVA, a 2x2x5 repeated measurement was used to analyse the significant H_{02} and $H0_3$ hypothesis. Repeated measurements were conducted of the 2x2x5 mean and of the two study groups (control and treatment), twice the measurements (pre and post) and five motivational domains.

H_{o2}: There is no significant main effect to groups and measurement tests on motivation in CT skills

H_{o3}: There is no statistically significant interaction effect between groups and measurement tests on motivation in CT skills

Table 10 shows the descriptive statistic for the pre and post test score mean for the motivation in computational thinking by group. Based on that table, the mean score of the post test of all motivational domains in computational thinking is higher than the pre-test score means. Fig. 2 shows the change in mean score for each domain of motivation in computational thinking across the test (measurement time).

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Table 10: Mean descriptive statistics of pre and post test scores for motivational domains in computational thinking by group

Groups		Mean	Std. Deviation	N
Intrinsic_Goal_Pre	Control	1.7611	.56144	45
	Treatment	1.8315	.50841	46
	Total	1.7967	.53348	91
Extrinsic_Goal_Pre	Control	1.6667	.46159	45
	Treatment	**1.6630**	**.44789**	**46**
	Total	1.6648	.45219	91
Task_Value_Pre	Control	1.5593	.41157	45
	Treatment	1.6703	.46280	46
	Total	1.6154	.43934	91
Control_of_Learning_Beliefs_Pre	Control	1.5593	.41157	45
	Treatment	**1.5543**	**.43113**	**46**
	Total	1.5568	.41923	91
Self_Efficacy_Pre	Control	1.5833	.41884	45
	Treatment	1.7065	.41768	46
	Total	1.6456	.42051	91
Intrinsic_Goal_Post	Control	3.6611	.33775	45
	Treatment	5.1033	.59994	46
	Total	4.3901	.87258	91
Extrinsic_Goal_Post	Control	3.8944	.38246	45
	Treatment	5.2880	.58918	46
	Total	4.5989	.85787	91
Task_Value_Post	Control	4.2741	.41462	45
	Treatment	5.3623	.59349	46
	Total	4.8242	.74799	91
Control_of_Learning_Beliefs_Post	Control	4.2556	.48992	45
	Treatment	5.3207	.85904	46
	Total	4.7940	.87923	91
Self_Efficacy_Post	Control	3.9833	.23926	45
	Treatment	5.2228	.53027	46
	Total	4.6099	.74625	91

Mean score Intrinsic Goal, M = 1.8315 (SD = 0.304), Extrinsic Goal, M = 1.6630 (SD = .44789), Task Value, M = 1.6703 (SD = .46280), Control of Learning Beliefs, M = For the pre-treatment group, while the mean score for the pre-control group, Intrinsic Goal, M = 1.7611 (SD = .56144), Extrinsic Goal, M = 1.6667, and Self Efficacy, M = 1.7065 (SD = (SD = .46159), Task Value, M = 1.5593 (SD = .41157),), Control of Learning Beliefs, M = 1.5593 (SD = .41157) and Self Efficacy, M = 1.5833 (SD = .41884). This shows that the control group's Extrinsic Goal and Control of Learning domain is above the mean score of the pre-treatment group as shown in the Fig. 2 graph of the mean score, of each score, of each domain of motivation (pre) by group.

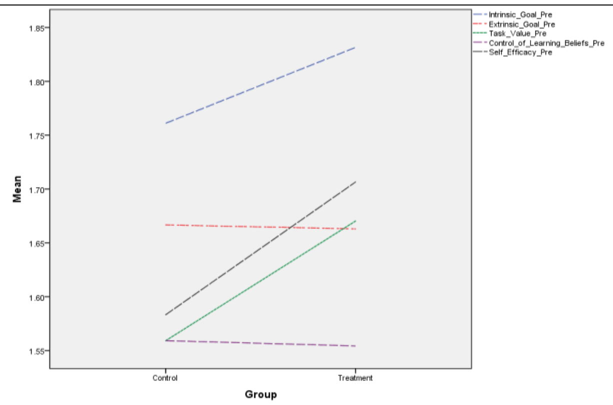

Fig. 2: The mean comparison using graph of the score of pre-motivational (domains) by group

Mean score Intrinsic Goal, M = 5.1033 (SD = .59994), Extrinsic Goal, M = 5.2880 (SD = .58918), TaskValue, M = 5.3623 (SD = .59349), Control of Learning Beliefs, M = 5.3207 = .85904), and Self Efficacy, M = 5.2228 (SD = .53027) for post treatment group, while mean score for post control group, Intrinsic Goal, M = 3.6611 (SD = .33775), Extrinsic Goal, M = 4.2556 (SD = .48992) and Self Efficacy, M = 3.9833 (SD = .43962), M = 4.2741 (SD = .41462) This shows that all the motivational domains of the control group (post) are over the mean score of the treatment group (post) as shown in Fig. 3 graph of the mean score of each of the domains of the motivation (post) by group.

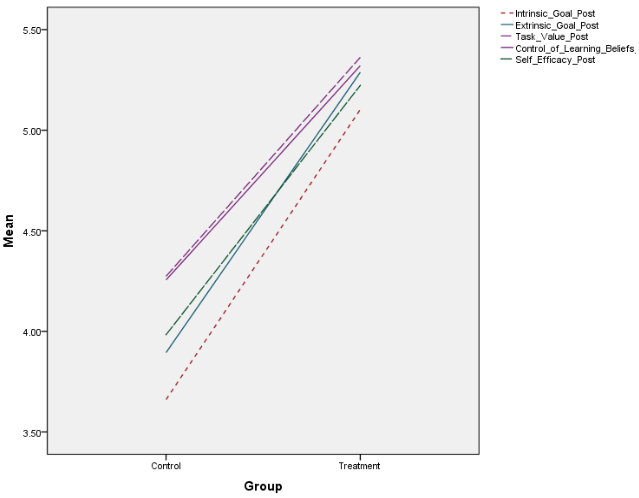

Fig 3: Mean comparison using a graph of the scores of post motivational domains by group

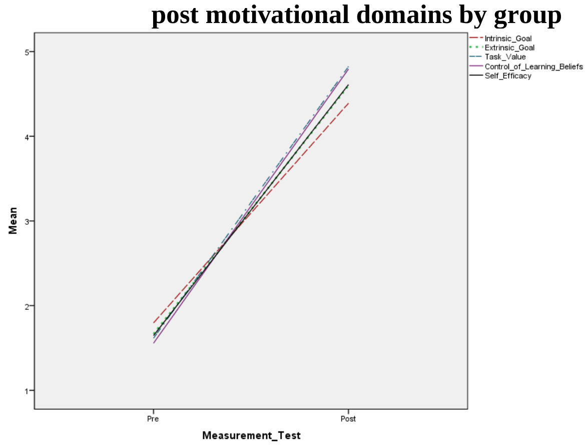

Fig. 4: Changes of graph in mean score of motivational domains according to measurement test (pre and post)

Based on Fig. 4, the mean score of all post motivational domains is over the pre-motivational score mean. Hence, the post-mean score for treatment and control groups is higher than the pre-score means for treatment and control groups. In addition, we used Pillai's Trace Value to identify whether there is a significant difference between dependent variables and independent variables. This is because the study has a small sample size and an uneven number of samples [28] Multivariate test Table 10 shows that there is a significant group effect on motivation [F (2, 89) = 1.623, p> 0.05] with an effect size of 0.057. The data also showed that there was a significant effect of the measurement time on motivation [F (2, 89) = 16.465, p> 0.05] with an effect size of 0.386. This shows that there is a major impact on the main effect to groups and measurement tests on motivation in CT skills. Hence, the H_{02} hypothesis failed to be rejected. The interaction effect between the measurement time and the group was also not significant towards motivation [F (2, 89) = 2.066, p <0.05] with the effect of 0.045. Therefore, the H_{03} hypothesis is rejected. This shows that there is no significant interaction effect between measurement time and group against motivation in computational thinking.

Table 11: Multivariate Testing

Effect	Value of Pillai's Trace	F	df1	df2	Sig	Partial Eta Squared
Group	0.057	1.623	2	89	0.156	0.057
Measurement Test	0.386	16.465	2	89	0.083	0.386
Group * Measurement_Test	0.045	2.066	2	89	0.045	0.045

Partial Value of Eta Squared is one of the statistics to determine the size of the effect. According to [29],the value 0.01 - 0.06 is interpreted as small, the value 0.06 - 0.14 is interpreted as simple and the value> 0.14 is interpreted as large. Table 10 above shows a small Partial Eta Squared value for the three effects of 0.057 (Group), 0.386 (Time) and 0.045 (Group and time). Based on these findings, it can be concluded that although the M-CT module and the conventional method each had the same impact on motivation among students, the comparison was descriptive that the M-CT module was better than the conventional method used. This is because the mean score in the control group (conventional method) and the treatment group (M-CT module) is significant according to the Measurement Test and the group.

VII DISCUSSION

Computational thinking skills play an important role in the development of a nation through the creation of a skilled and tech-savvy society. With this, most countries are aware of the importance of computational thinking skills in the 21st century, thus they have integrated CT into the curriculum. From this integration, students can be fully cognizant of CT and can contribute to national development. In addition, most institutions of higher learning are also aware of the importance of CT skills and have begun implementing CT in their respective institutions. Despite the advantages in CT, if an instructor fails to use the appropriate approach to teaching and learning, it will not only negatively affect students, but also the country [19]. Negative effects mean that students who fail to apply CT skills will perceive that CT skills are difficult to master.

Usually, this problem exists when instructors use teacher-based teaching approaches. This approach focuses more on the teaching of teachers, and where the students are fully dependent. This situation still exists in most higher education institutions that continue to use this method, and where the students are not actively involved in the teaching and learning process. Students who learn to memorize may answer questions that test lower-level cognitive skills, but they will face problems when doing tasks involving high order thinking skills.

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Furthermore, [19], [30], [31] conducted a literature review on studies related to CT skills and concluded that students had a lack of understanding on CT because they did not apply suitable approaches in the classroom, causing the achievement of students to be less satisfactory. According to [32], [33] CT skills should encourage students to practice through development. In the development process, the students can clearly see and facilitate the understanding of CT skills. This is because, most students, including certain people, still think that CT solves problems using a computer. The misunderstanding of concepts occurs when inappropriate approaches are used in the teaching and learning process. Additionally, they mentioned that instructors also play an important role in explaining CT skills through the use of appropriate approaches to facilitate student understanding.

Furthermore, according to [34] despite the advantages of producing problem-solving skills in all situations, teaching methods become a challenge in the teaching and learning of CT skills. It is also supported by [19], [35] that all new concepts introduced either in higher education or school become a challenge to instructors to make students understand the concept. Additionally, less relevant approaches are implemented in the teaching and learning process as the students do not have the motivation to try or apply CT in different situations [21]. Therefore, we intend to develop a module in CT learning to motivate the students who learn CT skills in higher education institutions.

VIII FUTURE WORK

Further, we evaluated the effectiveness of the module in terms of achievement and understanding. Achievement is a benchmark used to determine a goal or objective to achieve a predetermined level. In teaching and learning, student achievement is determined through test scores, grades or grades obtained in an examination [36]. In this further action, the achievement of computational thinking skills refers to scores obtained by students in a post-test given to students in both the control and treatment groups after the intervention process. Understanding refers to the ability to elaborate and interpret information in a given situation [37]. The level of understanding refers to how deeply the students understand the theories taught and whether they practice them [38]. The level of understanding covers many aspects of the mind's assessment of knowledge that changes from knowing to understanding. In the context of learning and teaching, it is not necessarily the teachers who teach well who will facilitate a good understanding among students [39]. We will evaluate the level of understanding through a three-dimension model of CT, namely concepts, practice and perspective to facilitate the understanding of CT. This idea refers to a study [40] which assesses students' development of computational thinking. These skills are evaluated using a Solomon four group design. This technique will be implemented during the selection of study respondents and the preparation of study instruments to minimize the threat in internal and external validity aspects. The selection of research respondents with the same attributes was also performed to obtain homogeneous study respondents.

XI CONCLUSION

This paper is about enhancing student's motivation to learn CT skills through the mobile application development module. These skills are developed using a quasi-experiment design of conventional and mobile application for the control and treatment groups. Besides, Mobile Application Development is an exciting subject among students. Besides that, demand for mobile applications in all industry sectors is growing and it also directly helps increase the country's Gross Domestic Product (GDP) [41]. Other than that, most of the plans were introduced in countries either as Internet of Things (IoT), 21st century skills or as industrial revolutions. All of these strategies focus and emphasise digital technology, hence the reason why we used the mobile application development model in this paper. Overall of the findings, it can be concluded that although the M-CT module and the conventional method each had the same impact on motivation among students, the comparison was descriptive that the M-CT module was better than the conventional method used. In the upcoming paper, we are going evaluate the effectiveness of a M-CT module in achievement and understanding among undergraduate students on computational thinking skills using the Solomon four group design.

APPENDIX

MOTIVATED STRATEGIES FOR LEARNING QUESTIONNAIRE (MSLQ)

ENHANCING STUDENTS' MOTIVATION TO LEARN COMPUTATIONAL THINKING THROUGH MOBILE APPLICATION DEVELOPMENT MODULE (M-CT)

Instruction: Please tick (/) only one answer to indicate your level of agreement or disagreement with the statements. The following questions ask about your motivation for and attitudes about this class. Remember there are no right or wrong answers, just answer as accurately as possible. Use the scale below to answer the questions. If you think the statement is very true of you, tick 7; if a statement is not at all true of you, tick 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

Intrinsic Goal: Intrinsic motivation is known as internal motivation. Intrinsic motivation arises to meet psychological needs. It is also a natural human feature to overcome all challenges and hurdles in order to get something they want.

Element	No.	Items	1	2	3	4	5	6	7
	1	In a class like this, I prefer course material that really challenges me so I can learn new things.							

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Element	No.	Items	1	2	3	4	5	6	7
Intrinsic Goal	2	In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.							
	3	The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.							
	4	When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.							

Extrinsic goal: Extrinsic Motivation is applicable from external factors. This type of motivation leads to the desire to act caused by external factors

Element	No.	Items	1	2	3	4	5	6	7
Extrinsic Goal	1	Getting a good grade in this class is the most satisfying thing for me right now.							
	2	The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.							
	3	If I can, I want to get better grades in this class than most of the other students.							
	4	I want to do well in this class because it is important to show my ability to my family, friends, employer or others.							

Task Value: A student's confidence will increase over an assignment because the academic task is important to him.

Element	No.	Items	1	2	3	4	5	6	7
Task Value	1	I think I will be able to use what I learn in this course in other courses.							
	2	It is important for me to learn the course material in this class.							
	3	I am very interested in the content area of this course.							
	4	I think the course material in this class is useful for me to learn.							
	5	I like the subject matter of this course.							
	6	Understanding the subject matter of this course is very important to me.							

Control of Learning Beliefs: Control of learning beliefs directly affects the level of effort and confidence to succeed in learning.

Element	No.	Items	1	2	3	4	5	6	7
Control of Learning Beliefs	1	If I study in appropriate ways, then I will be able to learn the material in this course.							
	2	It is my own fault if I don't learn the material in this course.							
	3	If I try hard enough, then I will understand the course material.							

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	4	If I don't understand the course material, it is because I didn't try hard enough.							

Self-Efficacy: Higher self-efficacy students have a strong expectation of the ability to succeed in the teaching and learning environment

Element	No.	Items	1	2	3	4	5	6	7
Self-Efficacy	1	I believe I will receive an excellent grade in this class.							
	2	I'm certain I can understand the most difficult material presented in the readings for this course.							
	3	I'm confident I can learn the basic concepts taught in this course.							
	4	I'm confident I can understand the most complex material presented by the instructor in this course.							
	5	I'm confident I can do an excellent job on the assignments and tests in this course.							
	6	I expect to do well in this class.							
	7	I'm certain I can master the skills being taught in this class.							
	8	Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.							

<<Thank you for your cooperation>>

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