A MODULE FOR INFUSION HIGH ORDER THINKING SKILLS (iHOTS) INTO MEASUREMENT AND GEOMETRIC AMONG FORM ONE STUDENTS

1st M.F. Rosool Gani
Faculty of Technical and Vocational Education
Universiti Tun Hussein Onn Malaysia
Johor, Malaysia
firusfairuz@gmail.com

2nd* W.H.N, Wan Muda,
Faculty of Technical and Vocational Education
Universiti Tun Hussein Onn Malaysia
Johor, Malaysia
wanhanim@uthm.edu.my

3rd F., Ab Halim
Faculty of Technical and Vocational Education
Universiti Tun Hussein Onn Malaysia
Johor, Malaysia
fazlin@uthm.edu.my

4th N. Ismail
Quest International University Perak
Perak, Malaysia
nurtasnim.ismail@qiu.edu.my

5th G. Khang Wen,
Faculty of Data Science and Information Technology, INTI International University, Nilai Malaysia
Faculty of engineering, Shinawatra University, Samkhok, Pathum Thani Thailand
Faculty of Mathematics and Natural Science, Universitas Negeri padang, Padang, Indonesia
khangwen.goh@newinti.edu.my

2024 9th International STEM Education Conference (iSTEM-Ed) | 979-8-3503-6597-9/24/$31.00 ©2024 IEEE | DOI: 10.1109/ISTEM-ED62750.2024.10663195

Abstract— One highly important ability for overcoming challenges in today's world is Higher Order Thinking talent (HOTS), particularly in the field of mathematics. therefore, the research conducted in the mathematics subject can improve by utilizing infusion Higher Order Thinking Skill (iHOTS) modules. A planning framework has been created using the four core competencies and overall competencies found in the revised Bloom's Taxonomy, which are also the main building blocks found in HOTS. Analyze, apply, evaluate, and create comprise the HOTS construct. A sample of the research involved 120 first-grade pupils from four different schools in the state of Johor. Data is gathered utilizing research decision tests pre- and post-testing before and after using the module for group treatment in this quasi-experimental study, whereas the conventional method for group control. The data analysis results indicate that action learning and facilitation (L&F), which is supported by the iHOTS module, can already raise students' dominance in mathematics across the board for all four HOTS levels. The research's conclusions indicate a substantial difference between the group control and the group treatment when it comes to the growth of the students' HOTS in mathematics while using the iHOTS technique for level apply, analyze, evaluate, create, as well as whole. To sum up, research like this can help everyone—the Malaysian Ministry of Education (MoE), the school administration, parents, mathematics teachers, and even students—by providing evidence of its efficacy in empowering HOTS mathematics in Malaysia through the enactment of relevant policies and applications.

Keywords— **HOTS, Infusion High Order Thinking Skills, Measurement and Geometric**

I. INTRODUCTION

The definition of the infusion approach to teaching thinking is the integration or combination of a few skills during the process of teaching and learning. This method uses the learning content to identify and teach different kinds of thinking skills [1].There are a few publications that concentrate on teachers to improve teaching ideas throughout curriculum, but the majority of published literature is primarily concerned with the accomplishments of students. Finding from [2] shows that beyond the problems found in mathematics content textbooks, there are opportunities to infuse aspects of good mathematics pedagogy into mathematics subject matter courses for aspiring elementary teachers. Since learning to infuse mathematics is a process, it is better to integrate pedagogy and content into the same course rather than teaching them separately as in traditional methods.

In Pisa 2022, Malaysia's results revealed a decrease in each of the three evaluated literacy metrics. In 2022, 24% of Malaysian students attended schools where the principal stated that a shortage of teachers was impeding the school's ability to deliver instruction (and 22%, that the personnel was insufficient or inadequately prepared), (PISA 2022 Results: Factsheets). The reason behind students' poor performance in mathematical argumentation is their limited comprehension of the significance of argumentation [3]. Mathematics has long been seen as a subject that is especially well-suited to the teaching and learning of higher-order thinking abilities like critical thinking in the context of education. Acquiring these skills is one of the objectives of mathematics courses in Israel and around the world. Moreover, they lack the necessary training to conduct persuasive arguments. They didn't look for the truth or assess whether the material was logical, accurate, and comprehensive. The dispositions of critical thinking in the

979-8-3503-6597-9/24/$31.00 ©2024 IEEE

students were absent. It is consistent with study findings showing pre-service math teachers did not yet possess critical thinking skills necessary for truth-seeking [4]. Mathematical reasoning gives pupils the ability to independently examine and validate the knowledge they are taught, as well as to think critically about it. The different critical thinking techniques could then be explicitly taught in the context of applying mathematics to address issues in practical settings. Students find the method and the outcomes more relevant when critical thinking is incorporated into the mathematics treatment because it provides a reflective element [5].

Teachers must create a environment for children by encouraging group projects, idea exchange, and creation to help them develop HOTS [6]. Among the instructional strategies that might improve students' grasp of critical thinking abilities and encourage their active participation in class. Previous research has demonstrated that student involvement and academic success in the classroom are significantly impacted by the quality of the teacher's instruction [7]. In actuality, classroom practice, professional development, and student progress are all impacted by teachers' comprehension of mathematics, the curriculum, and HOTS [8]. The development of modules based on critical thinking in mathematics education has received little attention. According to researches' findings from their need's analysis conducted concurrently with the study [7], instructors' major demands are related to the HOTS module. Teachers believe the module can be used as a reference, provide them a better understanding of HOTS, and give them more confidence to put HOTS into practice. Infusion teaching model by [9] underlies this study. This theory consists of *Introducing, Engagement, Reflection, Transfer* (IERT). The four ways consist of an introduction to lesson content and thinking skills or thinking processes; thinking through activity; thinking on thinking (meta cognitive); and also, the application of thinking. This study proposes guidelines for Malaysian math teachers to follow in designing and developing a module that uses the infusion teaching technique and HOTS for measurements and geometrics topics for form one students. This module is designed to help teachers impart more holistic thinking skills and is not restricted by classroom boundaries, allowing teaching and learning tasks to be executed properly.

II. INFUSION TEACHING APPROACH

According to [9], lessons designed use the infusion approach has two important purposes for teachers and students. The main purpose in this infusion approach is to form direct teaching by giving birth to skilled thinking (skillful thinking) in students and improve mastery of thinking in content learning itself. Second, this approach can improve mastery a deeper one about the content that is to the main objective in a teaching process.

According to [10], infusion is a teaching strategy in which pupils create and present their learning through an artistic medium. Students participate in a creative process that achieves changing goals in both art and other subject areas. Furthermore, by emphasizing active learning above passive learning, arts integration engages and inspires pupils. Given that students possess diverse learning methods and many intelligences, the arts offer a multitude of avenues for them to develop and exhibit their comprehension of academic content. This method of instruction provides students' learning more context and enhances the significance of their educational experiences. A method of teaching and learning known as infusion, or integration, combines the skills and content of one subject area (such as math, science, language arts, or social studies) with another subject area. With instructional objectives in both areas, the aim of this blending is to increase student understanding of both the subject area and that specific subject, enabling both disciplines to complement and strengthen one another [11].

[12] conceptualized the infusion approach to teaching critical thinking as a flow chat, going from top to bottom, consisting of an introduction, a thinking exercise, thinking about thinking, and applying thinking. This approach is used to teach and acquire critical thinking. The teacher introduces the lesson and gives directions on topic objectives and thinking skills. The teacher models utilizing thinking skills to solve learning difficulties in the thinking activity. Students work in groups to complete thinking tasks by using their topic knowledge and thinking abilities, and then present their group ideas to the class. The teacher guides students' reflection on the thinking process by posing questions throughout the thinking about thinking activity. At the bottom phase, the teacher provides additional opportunities for pupils to apply their thinking abilities to both comparable and distinct materials at the bottom stage, applying thinking. This framework suggests that the students need to have clear objectives and educational experiences. The students participate in activities as well as a stage when they reflect and apply the skills they have learned.

III. HIGHER ORDER THINKING SKILLS IN MALAYSIA

[13] introduced the idea of higher-order thinking in their taxonomy of education. The six components of the cognitive level are as follows: (1) knowledge; (2) comprehension; (3) application; (4) analysis; (5) synthesis; and (6) assessment. Bloom's taxonomy was changed into the following categories by [14] (1) remembering; (2) comprehending; (3) applying; (4) analysing; (5) assessing; and (6) producing. According to the new taxonomy, the first three stages of thinking are considered higher-order: (1) analyzing, (2) evaluating, and (3) creating. The last three levels are classified as lower-order thinking. Subsequently, a number of academics refined the definition of higher-order thinking, stating that it goes beyond rote memorization or following pupils' previous actions by using examples from existing literature. Working in complicated environments, applying non-algorithmic thinking, resolving unpredictable challenges, and generating multiple solutions are all associated with higher-order thinking skills [15].

The Ministry of Education (MoE) has provided the Malaysian education system with seven components for

implementing HOTS. Curriculum, pedagogy, and assessment are the three core components. The remaining four components which are cocurriculum, community and private supports, capacity building and resources, are considered as the supporting elements [16]. The MoE has released updated curricula known as Standard Curriculum for Secondary School (SCSS) and the Standard Curriculum for Primary Schools (SCPS), which support and strengthen the development of HOTS throughout the learning process. Teachers receive training on how to apply efficient pedagogical strategies and thinking aids. The Ministry introduced the i-THINK program in 2012. The Thinking Schools International (Kestrel Education, UK) is the source of inspiration for the i-THINK curriculum. The i-THINK program uses thinking maps created by David Hyerle as a practical way to help teachers and students incorporate higher level thinking processes into their teaching and learning techniques. Teachers and students are trained in this program to use tools and strategies for effective thinking in order to develop their HOTS. Teachers must increase their efficacy in the classroom so that it can be evaluated by students' mathematical achievement in order to support HOTS in their learning [17]. The HOTS and teaching methodology should be implemented from a young age forward to ensure that students acquire the skills and assistance needed to be proficient in mathematics. In order to improve their performance, teachers and students must also have optimistic views about learning this new strategy. Strongly optimistic emotions will help students learn mathematics more easily and perform better analytically [18]. [19] stressed out that using the HOTS and their own teaching style, math teachers could design a more effective lesson plan. The HOTS approach is an active learning strategy that was developed for 21st-century learning. As a result, students who employed the approach were able to understand more concepts, facts, and problem-solving techniques, which helped them become better decision-makers.

IV. METHOD AND PROCEDURE

Quantitative methods with a quasi-experimental approach (pre-test and post-test) were used in this study. There are pre- and post-tests in this experiment, which is constructed as a quasi-study by the researchers. Every involved school has two classes chosen: two treatment classes at SMK A and SMK B that use the iHOTS module to support T&L process while the other two classes are control groups, meaning that T&L using traditional methods are used at SMK C and SMK D to teach the same subject. Due to the instructors' request, the actual name of the school in question had to remain a secret. In conclusion, four classes are involved from four separate schools, two of which are control classes and the other two are control classes. The teacher administers the post-test after the lesson has ended, whereas the pre-test is provided prior to the instruction. After that, responders have three hours to finish answering the question. Teachers and researchers will mark the tests, and student scores will be kept on file. To increase the authenticity of the marks obtained, subjective tests should be graded by a few subject matter experts utilizing an answer scheme. The first marking is done by the subject teacher with using a red pen while the second marking is done by researchers and marked using a green pen. This verification process is in accordance with the method set by the Malaysian Examinations Board (MEB).

Researchers employ respondent groups in pairs that are nearly identical in terms of age (13 years old) and performance on the math subjects require grade C and higher. Respondents from schools A and B comprise two groups; these respondents are part of the treatment group, and respondents from schools C and D make up the other two groups that are part of the control group. The four courses that included both male and female students were used to choose the study subjects. A treatment class and a control class have each been chosen from among two classes. A sample consisting of 120 (one hundred and twenty) first grade students in four different schools. The sample of this study covers 60 (sixty) students selected to represent the group control while the same number of students (sixty) for the treatment group. This module is included in the learning Measurements and Geometry form one category and covers the themes of Area and Perimeter as well as Pythagorean Theorem under the SCSS learning measures.

V. DESIGN AND DEVELOPMENT MODULE

This module has been developed covering two topics under Measurement and Geometry in the Mathematics syllabus form one based on SSSC namely:
(i) Learning Sub-Modules I: Perimeter & Area
(ii) Learning Sub-Modules II: Pythagorean Theorem

Overall, this module contains supporting T&L methods using infusion approach of higher order thinking skills (iHOTS) based on Outside classroom learning (OCL) strategy. Each of these modules contains objectives, required materials, step-by-step methods and illustrated explanations. Formative evaluation is an integral part of the project development process, and teachers are able to do it at each session. Moreover, activities that are acceptable for assessment have been added at the conclusion of each module, along with summative assessments (pre- and post-tests). The ADDIE model was chosen because it is the most widely used instructional design model and it is not complicated to apply for this study. In fact, it promotes learning which is effective because it is more systematic and also explains the steps to design learning instructions. The context of this study is the ADDIE model used covering 5 phases as below:

(i) Phase 1: Analysis Phase (analyzing all information of interest)

The needs analysis phase is carried out before the design of learning strategies and learning activities are developed. This analysis focuses on the selection of titles and the content of the selected title, the need to use the iHOTS-OCL module and module level requirements to be used for all students. In this analysis phase, three main aspects have been used as indicators in making an accurate analysis to

ensure the relevance of this iHOTS-OCL module is guaranteed. These three aspects are summarized in Table 1 as follows:

Table 1: SCOPE OF NEEDS ANALYSIS

Scope Analysis	Description
Analysis Selection Title	Description related why title study this selected. Scope of the study also discussed. When a question is filed in an orientation that is neither standard nor complex in terms of numbers, students are unable to explain or identify angles. They are unable to comprehend the necessity for proper questions using words alone, particularly when it comes to high-level inquiries or specific scenarios. Generally speaking, students tend to memorize concepts that they are certain they comprehend without really understanding them. They were unable to demonstrate how the solution was arrived at when the teacher questioned them. This is due to the fact that there was insufficient tangible available earlier for the pupil to build new knowledge.
Analysis Necessity Usage Modules	Description about requirements modules this published and used based on requirements against student and also teacher. Measurement & Geometry for Curriculum Secondary School Standard (KSSM) does not have any specific modules for the topic of study, according to information provided by several secondary school math teachers. Thus far, instructional modules in Measurement and Geometry have only been released for the Standard Curriculum for Primary Schools (SCPS)
Analysis Necessity Level	Discussion related suitability modules this used according to level environment student school in Malaysia covering suitability group target; suitability title; and cost which engaged.

(ii) Phase 2: Design Phase (designing the iHOTS-OCL module)

The module design phase is a very important phase. Design phase modules iHOTS-OCL this involve aspects necessary taken into account before and current they shape modules. Summary phase design shape study this is based on Table 2 below:

Table 2: DESCRIPTION OF DESIGN iHOTS-OCL MODULE

Sub Topic	Description
Design Shape Framework Modules	Module construction iKBAT-PLBD involves three component main cognitive which support between one same other that is visualization, construction and reasoning.
Design of Modules	At this stage things are involved in the design the shape of a module must be arranged in an orderly manner so that more nature systematic. Things this is covering: i. Goals & Objectives of the iHOTS-OCL ii. Stating Topic iii. Background Behind the OCL Project & Concept Mathematics Related iv. Daily Teaching PLan (DTP) v. Elect & Build Media for T&L vi. Production of Learning Activities and Facilitation vii. Standard Content (SC) & Standard Mastery (SM)
Features Modules iHOTS-OCL	Features modules iHOTS-OCL: i. Creative & Innovative *ii. H ots Friendly* iii. Graphics Colored iv. Text v. Visual Modules

(iii) Phase 3: Development Phase (developing the iHOTS-OCL module)

In this stage, the iKBAT-PLBD module that has been designed next will giving focus to develop modules iKBAT-PLBD for every instruction learning also. Hal this included develop activity learning based PLBD for two topics in down field learning Measure and Geometry and develop learning phases based on PLBD activities which in tandem with *Theorem Pythagoras* and Perimeter & Area. Inner phase development this, three aspect main given attention like following:

Table 3: DEVELOPMENT PHASE MODULES iHOTS-OCL

Scope	Description
Arrangement Activities OCL	Introduction related to the organization of activities based PdPc outside room degree for empowering understanding KBAT
Develop Activities Modules iHOTS-OCL	Description related modules iKBAT-PLBD which giving focus to Phase 1 (Information), Phase 2 (Orientation guided), Phase 3 (Description), Phase 4 (Orientation Free) and Phase 5 (Integration)
Development of Daily Teaching Plan (DTP)	Description related content RPH covering Standard Learning, Element Across Curriculum (EAC) and i-Think Map
Development Modules iHOTS-OCL	Explain development modules which constructed included size modules and illustration.

(iv) Phase 4: Implementation Phase (using the current iHOTS-OCL module in T&L process)

At this point, a pilot research based on iHOTS-OCL has been conducted outside of classrooms. This pilot research is required in order to address and strengthen any weaknesses and inadequacies present in the courses. Examine the researcher's pilot project in order to assess multiple factors. This includes (a) giving the instructor sufficient and relevant training; (b) tailoring the PLBD activity based on the HOTS level of difficulty; (c) selecting the group goal for the activities; and (d) carrying out the T&L-based iHOTS-OCL activity. Enough training is essential to guarantee that the participating teachers are knowledgeable enough to conduct PdPc based modules, such as iHOTS-OCL. The training that is provided is often top-notch and provided face-to-face. Face-to-face explanations are generally conducted to provide an early picture of the objectives, prerequisites, and procedure of T&L. They are given enough time to ensure that they fully comprehend this module. The teachers need that time since they have important responsibilities that they must prioritize at school. Sample images and sample videos are continually published on social media platforms such as WhatsApp and Telegram, so that users may see clear examples of how to use the iHOTS-OCL modules.

Researchers make sure that test are completed at low, medium, and high level of difficulty based on the complexity. It has been reorganized, and researchers covering low levels have chosen 50% of the questions. Only 20% of the questions are complex or high level, with the remaining 30% representing simple levels. This can guarantee that every question is more equitable for every student group. Specifics regarding the degree of difficulty are mentioned for every question that is submitted. The goals of the students were to gather data, categorize both quantitative and qualitative data in general, predict, communicate, experiment, and develop a variety of other abilities related to basic process mathematics that they might use and apply throughout the OCL project. As part of the OCL procedure, students are required to complete pre-given assignments based on specific guidelines and conditions. Students must comprehend the assigned case that is provided.

(v) Phase 5: Evaluation Phase (assessing the effectiveness of the iHOTS-OCL module)

The final phase of development modules based on this ADDIE paradigm is called phase evaluation. Comments from seasoned legal professionals regarding the components used in this module, including topic selection, idea suitability, mathematics, and an assessment project that was built and used as a decision-making tool for modules that were previously established. Phased assessments are generally conducted to guarantee well-acquired, high-quality modules.

Table 4: SUMMARY ASSESSMENT PHASE MODULES iHOTS-OCL

Scope Discussion	Description
Criteria Assessment Against Modules iHOTS-OCL	There are nine criteria found in this module that are necessary evaluated by experts validity including module cover, goals, teacher evaluation, activities and reflection.
Expert Evaluation Module Validity iHOTS-OCL	Assessment validity content and validity face module, comment, recommendations and corrective action explained in section this.
Implement Test Pre and Post Test	Pre-tests are conducted before the intervention program is conducted for both two treatment groups were conducted. The teaching process as usual remains conducted for the control group. Next, test post conducted for compare achievement both group.

VI. FINDINGS AND DISCUSSIONS

120 respondents represent four classes from four different schools, each of which covers a control group of 60 participants and an additional 60 pupils for treatment group. Each student is given three hours to complete all of the questions.

Following the completion of the OCL session, students in the treatment group were assessed again using tests that were nearly identical for evaluate. These tests included modules that were specifically created to support students' HOTS achievement and problem-solving skills. This test has the same duration as the last one. The data are analyzed and will be further explored based on student achievement outcomes and ability to respond. At the end of the inner phase, the modules that had already been built and tested for efficacy and student achievement at the HOTS level were presented. Twenty math achievement exam questions from the KBAT were used in the data analysis. Test that covers the learning areas of measure and geometry; presented in the form of a summative test. Each question will assess the respondent according to the achievement score they received for the topics of Area and Perimeter and Pythagoras' Theorem.

The results of this study were also analyzed using the historical Statistical Package for the Social Sciences (SPSS) 24.0, which provided desk research on frequency, mean, and variance. In addition to this, inferential analysis has also been used to consist of the MANCOVA and MANOVA test.

VIII THE EFFECTIVENESS OF IHOTS-OCL MODULE TOWARDS MATHEMATICS HOTS ACHIEVEMENTS BETWEEN TREATMENT GROUPS AND CONTROL GROUP

All four focused variables; applied, analytical, evaluate, and creative skills were found to be growing for the control group and the treatment group after the end of the experimental period, according to the findings of the descriptive analysis that was conducted. In contrast to the control group, the treatment group showed a more notable rise in minutes for each of the four variables: evaluate

(14.87), applied (9.30), analytical (13.40), and creative skills (11.57). The findings demonstrate that the treatments administered during the trial had an impact. This may demonstrate that the iHOTS-OCL module can improve students' performance on the HOTS for mathematics courses in the areas of application skills, analytical skills, evaluate skills, and creative abilities, with the treatment group outperforming the control group. A summary of the HOTS descriptive analysis of mathematics disciplines among students is presented in Table 5.

Table 5: MEAN AND STANDARD DEVIATION OF TREATMENT AND CONTROL GROUPS FOR iHOTS

Variables	Group	Test	Mean	SD
Apply	Treatment	Test Pre	59.20	4.93
		Test Post	68.50	5.10
		Upgrades	+ 9.30	
	Control	Test Pre	62.90	5.27
		Test Post	63.07	5.21
		Upgrades	+ 0.17	
Analyze	Treatment	Test Pre	52.50	4.64
		Test Post	65.90	5.76
		Upgrades	+13.40	
	Control	Test Pre	56.00	5.17
		Test Post	56.27	5.15
		Upgrades	+0.27	
Assess	Treatment	Test Pre	50.20	4.68
		Test Post	65.07	6.15
		Upgrades	+14.87	
	Control	Test Pre	53.57	4.53
		Test Post	53.93	4.53
		Upgrades	+ 0.36	
Creating	Treatment	Test Pre	56.53	5.69
		Test Post	68.10	5.51
		Upgrades	+ 11.57	
	Control	Test Pre	59.73	5.06
		Test Post	60.33	4.44
		Upgrades	+ 0.60	

Based on the descriptive analysis, it is clear that students in the treatment group acquire higher levels of HOTS for mathematics topics in terms of applied, analytical, evaluate and creative abilities. The MANCOVA test is used to look at the impact of the iHOTS-OCL module on the achievement of KBAT for mathematics subjects among students from the aspects of achieving applied skills, analytical skills, evaluate skills and creative skills more precisely. Table 6 shows a multivariate test analysis that contains Pillai's Trace, Wilks' Lambda, Hotelling'sTrace and Roy's Largest Root. Pillai's Trace has been selected and used in this analysis based on its capabilities that can be used for any solid number of groups. Income indicates that there is a statistically significant impact on the study group for each base variable, i.e. application skills, analytical skills, evaluate skills and creative skills among students after controlling the pre-examination covariate of each base change, $F (4, 51) = 139,750$, $p < 0,05$, $\eta 2 = 0,916$.

Table 6: SUMMARY OF MULTIVARIATE TEST FOR TREATMENT GROUPS AND CONTROL GROUPS

Test		Value	*F*	Value *P*	Partial Eta [2]
	Pillai's Trace	0.204	3.266 [b]	0.018	0.204
	Wilks' Lambda	0.796	3.266 [b]	0.018	0.204
Intercept	Hotelling's Trace	0.256	3.266 [b]	0.018	0.204
	Roy's Largest Root	0.256	3.266 [b]	0.018	0.204
	Pillai's Trace	0.634	22.074 [b]	0.000	0.634
Pre Test Apply	Wilks' Lambda	0.366	22.074 [b]	0.000	0.634
	Hotelling's Trace	1.731	22.074 [b]	0.000	0.634
	Roy's Largest Root	1.731	22.074 [b]	0.000	0.634
	Pillai's Trace	0.167	2.548 [b]	0.050	0.167
Pre Test Analyze	Wilks' Lambda	0.833	2.548 [b]	0.050	0.167
	Hotelling's Trace	0.200	2.548 [b]	0.050	0.167
	Roy's Largest Root	0.200	2.548 [b]	0.050	0.167

Based on the results of the MANCOVA test analysis findings shown in Table 7, there are statistically significant differences between the study groups for applied skills [$F (1, 54) = 111.093$, $p < 0.05$, $\eta 2 = 0.673$], analyzed [$F (1, 54) = 152.591$, $p < 0.05$, $\eta 2 = 0.739$], evaluate skills [F1, 54) = 198.245, $p < 0.05$, $\eta 2 = 0.786$] and creation [$F (1, 54)=145.158$, $p < 0,05$, $\eta 2=0.729$]. Additionally, the effect size value of 0.673 – 0.786 of the tested variables has shown that the modules studied have had a positive effect on the improvement of student HOTS skills from the application skills, analytical skills, evaluate skills and creative skills aspects.

The analysis proceeded in greater depth by looking at the variable differences of the study by controlling the covariate. The results of the analysis showed that there were statistically significant differences in the pre-application test covariate for applied skills [$F (1, 54) = 82,940$, $p < 0,05$, $\eta 2 = 0,606$], the pre analytical skill test covariate for analytical skills ($F (1,54) = 10,573$, $p < 0.05$, $\eta 2 = 0,164$), the statistically significant pre-evaluate test covariate for evaluate skills ($f (1, 55) = 9,450$, $p <0,05$, $\eta 2= 0,149$) and the statistically significant pre creation test covariate for inventory skills ($F (1, 5 4) = 103.084$, $p <0.05$, $H2 = 0.656$). Next, the overall findings of the study found that the iHOTS-OCL module used had an impact on HOTS achievement from the applied aspect of 78.7%, analytical 81.6%, evaluate skills 81.6 percent and creative 79 percent. This, has proven that this iHOTS-OCL module has had a positive impact on students in improving the achievement of the mathematics subject HOTS. The achievement of this positive effect is to include achievements of applied, analytical, evaluate and creative skills.

Table 7: DIFFERENCES BETWEEN INDEPENDENT AND COVARIATE VARIABLES ACROSS DEPENDENT VARIABLES

Source	Dependent Variables	Type III Total power two	F	Value *P*
	Apply	1562.002 [a]	39.958	0.000
Model	Analyze	2546.601 [b]	47,750	0.000
corrected	Evaluate	2896.329 [c]	47,780	0.000
	Creating	1861.624 [d]	40,653	0.000
	Apply	16.036	2.051	0.158
Intercept	Analyze	93.156	8.734	0.005
	Evaluate	2.278	.188	0.666
	Creating	12,795	1.397	0.242
	Apply	648,441	82,940	0.000
Test Pre	Analyze	12,590	1.180	0.282
apply	Evaluate	12.508	1.032	0.314
	Creating	2.808	.307	0.582
	Apply	2.346	.300	0.586
Test Pre	Analyze	112,780	10.573	0.002
analyze	Evaluate	0.051	.004	0.949
	Creating	1.485	.162	0.689
	Apply	7.369	.943	0.336
Test Pre	Analyze	0.072	.007	0.935
evaluate	Evaluate	114.572	9,450	0.003
	Creating	19.389	2.117	0.151
	Apply	0.467	.060	0.808
Test Pre	Analyze	63.555	5.958	0.018
create	Evaluate	8.120	.670	0.417
	Creating	944.092	103.084	0.000
	Apply	868.547	111.093	0.000
Group	Analyze	1627.591	152.591	0.000
	Evaluate	2403.427	198.245	0.000
	Creating	1329,430	145.158	0.000
	Apply	422.181		
Error	Analyze	575.982		
	Evaluate	654.671		
	Creating	494,560		

Students' HOTS Achievements for Measurement and Geometry of the Treatment Groups Before and After the Intervention Programme Executed

The results of the descriptive analysis findings of students' HOTS achievements for the treatment group for the field of learning Examination and Geometry that have been carried out have shown improvements for each variable namely application skills, analytical skills, assessment skills and creative skills. Application skill variable shows an increase in the number of mean 9.3 after the intervention program is completed. Analysis skills showed an increase of 13.4 mean, evaluation skills indicated an improvement of 14.87 mean and finally an increase in 11.57 mean was shown for creative skills in mastering student HOTS achievement after completion of the intervention program implemented. Therefore, the findings from this descriptive analysis clearly indicate that this iHOTS-OCL module has had a positive impact on student HOTS achievement for the treatment group after interventions were carried out in the application, analytical skills, evaluation and creative skills aspects. Table 8 illustrates the descriptive analysis of treatment group.

Table 8: DESCRIPTIVE ANALYSIS OF VARIABLES FOR TREATMENT GROUP

Enabler Change	Test	Mean	SD
Apply	Test Pre	59.20	4.93
	Test Post	68.50	5.10
	Total	63.85	6.83
Analyze	Test Pre	52.50	4.64
	Test Post	65.90	5.76
	Total	59.20	8.52
Evaluate	Test Pre	50.20	4.68
	Test Post	65.07	6.15
	Total	57.63	9.25
Creating	Test Pre	56.53	5.69
	Test Post	68.10	5.51
	Total	62.32	8.05

The results of a multivariate test analysis based on Pillai's Trace values have found that there are statistically significant differences in the treatment group for the focused variable, namely student mastery achievement of HOTS in the aspects of applied skills, analytical skills, assessment skills and creative skills after completion of the intervention program carried out, F (4, 55) = 64,568, $p < 0.05$, $\eta 2$ = 0,824. Table 9 shows the multivariate test findings that have been analyzed.

Table 9: MULTIVARIATE TEST FOR iHOTS ACHIEVEMENT AMONG TREATMENT GROUP

		Value	*F*	Value *P*	Partial Eta^2
Intercept	Pillai's Trace	0.998	7056.413[b]	0.000	0.998
	Wilks' Lambda	0.002	7056.413[b]	0.000	0.998
	Hotelling's Trace	513.194	7056.413[b]	0.000	0.998
	Roy's Largest Root	513.194	7056.413[b]	0.000	0.998
Test	Pillai's Trace	0.824	64.568[b]	0.000	0.824
	Wilks' Lambda	0.176	64.568[b]	0.000	0.824
	Hotelling's Trace	4.696	64.568[b]	0.000	0.824
	Roy's Largest Root	4.696	64.568[b]	0.000	0.824

The following results of the analysis findings of the MANOVA exam in table 5.10 show that there are statistically significant differences in the treatment group for the achievement of mastery of KBAT students from the applied skill aspects [F (1, 58) = 51.599, $p < 0.05$, $\eta 2$ = 0.471], analytical skill [F (1,58) = 98.485, $p < 0,05$, η 2 = 0,629], assessment skills [F (1.58) = 110.977, p< 0,05; $\eta 2$= 0,657] and creation skills (F (1.58), = 110,977, $P < 0.05$; $\eta 2$, = 0.524) after completion of the intervention program. Additionally, a simple effect size value of 0.471 – 0.657 for the variable studied indicates that there is a simple positive effect in the improvement of the student's HOTS skills from the application skills, analytical skills, judgment skills and creative skills aspects. It proves that the achievement of mastery of HOTS in student mathematics subjects from the mastery aspects of applied skills, analytical skills, assessment skills and creative skills increases before and after the completion of intervention programmes run. Overall, the findings of the study found that the iHOTS-

OCL module used had an impact on the achievement of mastery of HOTS for mathematics subjects of students from the mastery aspects of achieving applied skills i.e. 47.1%, analyzing skills is as much as 62.9%, skill rating 65.7%, and finally creation is 52.4%. The income also clearly proves to us that the iHOTS-OCL modules that have been used in this study have had a positive impact on the achievement of the mastery of HOTS in mathematics subjects among students in the aspects of mastery achievements of applied, analytical skills, evaluation and creation skills.

Table 10: DIFFERENCES OF HOTS ACHIEVEMENT BEFORE AND AFTER INTERVENTION FOR TREATMENT GROUP

Source	Dependent Variables	Type III Total power two	*F*	*Value P*
	Apply	1297.350 [a]	51.599	0.000
Model	Analyze	2693.400 [b]	98.485	0.000
corrected	Evaluate	3315.267 [c]	110.977	0.000
	Creating	2006.817 [d]	63.948	0.000
	Apply	244609.350	9728.686	0.000
Intercept	Analyze	210278.400	7688.909	0.000
	Evaluate	199296.067	6671.319	0.000
	Creating	233002.017	7424.659	0.000
	Apply	1297.350	51.599	0.000
Test	Analyze	2693.400	98.485	0.000
	Evaluate	3315.267	110.977	0.000
	Creating	2006.817	63.948	0.000
	Apply	1458.300		
Error	Analyze	1586.200		
	Evaluate	1732.667		
	Creating	1820.167		

OCL teaching procedures have proven to be effective in improving the acquisition of conceptual knowledge and the ability to apply problem-solving skills in learning transfer. The study also found that the OCL teaching environment was also effective in reducing student mental effort especially during the learning phase, by reducing irrelevant burdens and at the same time stimulating relevant. The post-examination results of the study found that the achievement of the treatment group students as well as their respective control group students showed a positive improvement compared to the pre-exam. However, the differences in student achievement in the treatment group in the post-exam were higher. Each variable in the treatment group has a more positive effect than the outcome of achievement in the control group and this indicates that the outcomes of the treatment groups are better. This proves that the iHOTS-OCL module has had a positive impact on students in terms of application skills, analytical skills, assessment skills and also creative skills.

Several practical and theoretical aspects of teaching design provide an explanation of the effectiveness of this iHOTS-OCL module. The explanation of the achievement of positive results in this study is that the objectives of the study have been established by the previous researcher. This study has established two (2) primary study objectives on developing and studying the effectiveness of modules that use the Infusion Approach of Outside-Class Learning (OCL) in the field of Scale and Geometry learning to apply high-level thinking skills (HOTS) among form one students.

These modules that infuse or dismantle high-level thinking skills using an out-of-class learning approach have been found to attract students' interest in mathematics. As many people know, hands-on or practical learning can give more understanding to students. [20] also explains that learning outside the classroom can enhance student understanding better, especially those involving difficult subjects or concepts such as mathematics. Besides that, the T&L process run with the help of this iHOTS-OCL module can give a strong confirmation of the knowledge in the student.

The study's findings indicate that, in comparison to students who were taught using traditional teaching and learning methods those who were taught using the iHOTS-OCL module had better knowledge. When compared to students taught using practical teaching techniques, students taught using the module-based methods of this module also benefit in terms of improving the mastery of the level of applied skills. Students who use the modulus-driven method of the iHOTS-OCL modulus specifically outperform students who educate using the traditional way in terms of gaining mastery in the skill level of analysis.

The treatment group, which used the iHOTS-OCL module, and the control group, which used standard T&L methods, expended about the same mental energy in answering the assessment skill level question, in terms of cognitive burden. In contrast to students who have been taught using traditional ways for answering the problem, students who are taught using the T&L approach using the iHOTS-OCL module find it easier to understand the question's context. This demonstrates how students' mastery of the assessment skills can be enhanced by using the iHOTS-OCL modulus approach.

The study's findings also shown that throughout the learning phase, students instructed utilizing the T&L approach based on the iHOTS-OCL module were able to complete tasks without the need for traditional methods. When it came to the degree of creative skills, students who were taught using the module methods also considered it relatively easy to comprehend the context of high-level problems in comparison to students who were taught using the traditional way.

The capacity to application skills and ideas regarding an issue in a novel setting is known as the application skill. At this point, the students will use what they have learned in a fresh, unique, and practical circumstance [17]. Students currently possess knowledge that they have acquired from free experience. Students can then apply that knowledge to address fresh issues. The reason for this is that a new problem has an element that is slightly different from the preceding problem. For instance, while solving a new problem, pupils shouldn't merely swap out names or numbers. In order to address an issue in a novel setting, students in this scenario only apply the theories, concepts, laws, processes, and other knowledge they have acquired.

The behavior of the student to solve a task problem at this level is as follows:

(i) Identify the assigned OCL tasks by defining the type and desire of the given tasks, removing irrelevant matters and rearranging information in an easy-to-solve form or pattern.
(ii) Adhere to the relevant principles, concepts or generalizations to be used in the process of preparing the OCL task.
(iii) Effectively solve mathematical problems using OCL approaches.

An analytical skill is the cognitive ability of an individual to separate a set of communications into elements or parts of them so that a form of association between the elements or the parts that make up the set of communication can be clearly seen. At this stage too, students may be able to solve things into small parts, outline similarities and differences and solve problems they face, [21]. Bloom, along with his colleagues, divided analytical skills into three stages: element analysis, correlation analysis, and organizational analysis.

The ability to recognize the core idea or element included in a collection of communications, such as assumptions, opinions, characteristics, purposes, values, and so on, is known as analysis skill. which are used in the following activities:

(i) Use mathematical communication set statements to find and recognize facts.
(ii) Differentiate the statement's supporting conclusion.
(iii) Recognize presumptions that aren't stated clearly in mathematical communication sets.
(iv) Determine the motif present in the artwork, image, or painting.

Finding shows that students in the treatment group achieve higher minimum scores in the HOTS analytical skills mastery areas. [22] stated that the level of HOTS evaluation is a stage in which students can make a qualitative or quantitative or both consideration of material values and methods specific to a given criterion. Bloom, along with his colleagues, divided the ability to make assessments into two stages: an assessment based on internal evidence and an evaluation based on external evidence. The ability of students to make decisions utilizing regular procedures and criteria to identify acceptable, accurate, and efficient techniques can be compromised by HOTS activities.

A synthesis, often known as a creative skill, is a cognitive ability that integrates multiple components and elements to create a communication set. Putting things together and combining it to create a previously unclear structure, presentation, or pattern is what this rank entail. These creative or synthesizing skills are more achievable and creative thinking than other cognitive skill levels; that is, students' responses or presentations are reasonably autonomous and distinctive. According to [20], at this point, pupils will be able to put materials or elements together to generate a certain conclusion. creative stage refers to the process of creating something new out of knowledge acquired in a setting that is significantly different from the original context. By using the OCL method, students should aim to generate a fresh concept that addresses the issue that comes up during work preparation. This study unequivocally demonstrates that students in the therapy group perform better on the cognitive test of creative abilities.

VIII CONCLUSION

The iHOTS-OCL module, the module with three key components and five implementation parts, has been proposed in light of the successful outcomes of this study's implementation. Additionally, a set of OCL teaching processes particular to mathematical subjects that can be expanded to cover other topics in the future have been proposed and built by the researchers. For T&L, or for student-centered learning research development for all other topics, OCL-based teaching methods and module-specific lesson plans that are helpful to stakeholders in schools across Malaysia, are also available.

ACKNOWLEDGMENT

This paper supported by Centre of Leadership & Competency, Registrar Office University Tun Hussein Onn Malaysia.

REFERENCES

[1] Z. Zulkpli., A.H. Abdullah, U.H. Abdul Kohar, and N.H. Ibrahim (2017), "A Review Research on Infusion Approach in Teaching Thinking: Advantages and Impacts." Man in India. 97(12): 289-298

[2] A.S . Marzocchi, and J. DiNapoli, (2020), "Infusing Pedagogy in Mathematics Content Courses for Future Elementary Teachers." Issues in the Undergraduate Mathematics Preparation of School Teachers

[3] L.B. Tristanti & T, Nusantara, (2022), "The influence of infusion learning strategy on students' mathematical argumentation skill." *International Journal of Instruction*, *15*(2), 277-292. https://doi.org/10.29333/iji.2022.15216a

[4] D. Kurniati, Purwanto, A. As'ari, & Dwiyana. (2019). The Truth-Seeking and Open- Mindedness of Pre-Service Mathematics Teachers in the Solution of Non-Routine Problems. *International Journal of Instruction*, *12*(1), 915-930

[5] E. Aizikovitsh-Udi, (2019), "Construction of Critical Thinking Skills by the infusion approach in Probability and Statistics in Daily Life". HAL: Open Science

[6] J. Mintzes, J. J., & Walter, E. M. (Eds.). (2020). Active learning in college science: The case for evidence-based practice. Springer Nature.

[7] R. Othman, N. Mohd Tajudin, M. Adnan, (2021), "Needs Analysis forDeveloping A Thinking-Based Learning Module InMathematics Learning." Turkish Journal of Computer and Mathematics Education Vol.12 No.4 (2021), 1165-1172

[8] N. Mohd Tajudin, Z. Zamzamir, & R. Othman, (2019): Thinking-Based Learning Module for Enhancing 21 st Century Skills. International Journal of Innovative Technology and Exploring Engineering (IJITEE)

[9] R. Swartz, & S., Parks,(1994). *"*Effective Teaching Evidence And Pratice*"*. London : Daniel Mujis And David Reynolds.

[10] Pine Street Elementary School (2021), "What is infusion", available at: https://www.spartanburg7.org

[11] J.O. Oborah, (2022), "Effectiveness of the infusion teaching approach for the development of general ICT skills in Nigerian tertiary education." Journal of Research in Innovative Teaching & Learning Vol. 15 No. 2, 2022 pp. 245-258 Emerald Publishing Limited

[12] Y. Lin, (2018), "The infusion approach", in Developing Critical Thinking in EFL Classes, Springer, Singapore, doi: 10.1007/978-981-10-7784-5_2

[13] Bloom, B., Englehart, M., Furst, E., Hill, W., & Krathwohl, D. R. (1956). Taxonomy of educational objectives: The classification of educational goals Handbook I: Cognitive domain. New York: Addison Wesley Longman, Inc.

[14] Anderson, W. L., & Krathwohl, D. R. (Ed). (2001). A Taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. New York: Addison Wesley Longman, Inc

[15] Thomas, A., & Thorne, G. (2014). Higher-order thinking. Retrieved from http://www.readingrockets.org/article/higher-order-thinking.

[16] F.N. Abu Hassan, Q.A. Mohamad, N.A. Mohd Rosli, M.T. Ajmain@Jima'ain, and S.K. Yusof Azuddin, (2020), "The Implementation of Higher Order Thinking Skills (Hots) in Malaysia Secondary School: Post PISA 2009." International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 05

[17] M.Khalil, R.A. Farooq, E. Çakiroglu, U. Khalil, & D.M. Khan,. (2018). "The development of mathematical achievement in analytic geometry of grade-12 students through GeoGebra activities." Eurasia Journal of Mathematics, Science and Technology Education, 14(4), 1453– 1463.

[18] S.A. Bakar, A.F.M. Ayub, K. Gopal, & N.R. Salim, (2019), "The Influence of Students' Beliefs on Mathematical Problem Solving towards Mathematics Achievement among Malaysian Matriculation Students." Universal Journal of Educational Research. 7(10), 2243-2247.

[19] M. Mahmad, M. Yee, T. Tee,& N. Azid, (2021). HIGHER ORDER THINKING SKILLS AND TEACHING STYLE IN MATHEMATICS PRIMARY SCHOOL: A REVIEW. *International Journal Of* Education And Pedagogy, 3(1), 1-21

[20] English Outdoor Council (2015). High Quality Outdoor Learning. United Kingdom.

[21] C. B. Gek (2017). Knowledge and Higher Order Thingking Skills Application among Technical Schhocl Teachers. Universiti Tun Hussein Onn Malaysia (UTHM). PhD Thesis.

[22] B.G. Chew Bee (2017). "Pengetahuan Dan Pengaplikasian Kemahiran Berfikir Aras Tinggi Dalam Kalangan Guru Teknik Dan Vokasional". Universiti Tun Hussein Onn Malaysia (UTHM). Tesis Doktor Falsafah