

## C-CHIL: A NEW LEARNING MODEL FOR ADVANCED MATHEMATICS COURSE IN THE SOCIETY 5.0 ERA

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### Abstract

University graduates in the Society 5.0 era need more skills than ever before; thus, a new learning model is needed. To respond this situation, we created a learning model that equips students to think critically, creatively, and independently through Advanced Mathematics courses using hybrid learning. This study aims to produce a model that can meet the needs of Moodle-based hybrid learning. Through research and development (R&D), we developed a learning model through the “Brilliant” application. The Critical Creative Hybrid Independent Learning (C-CHIL) model test was conducted regarding (1) quality which includes the content and constructs of the model, and (2) feasibility. The validity test was carried out by three learning experts using a questionnaire instrument with a Linkert scale of 1-4. The test results of the C-CHIL model show that (1) Content validity test resulted an average of 3.73 which means the model is very valid. (2) The average feasibility test is 3.63, which means it is also very valid. Thus, it can be concluded that the C-CHIL model meets the valid requirements (content and construct) and is suitable for students based on expert opinion. The results of this study imply that the C-CHIL model can be used to improve critical, creative, and independent thinking skills, especially in Advanced Mathematics courses in Higher Education.

**Keywords:** Creative thinking; critical thinking; society 5.0; advanced mathematics; independent learning.

### Abstrak

Lulusan perguruan tinggi di era Society 5.0 semakin membutuhkan keterampilan yang lebih dari era sebelumnya. Untuk itu diperlukan model pembelajaran baru yang membekali mahasiswa agar mampu berpikir kritis, kreatif, dan mandiri melalui mata kuliah Matematika Lanjut dengan menggunakan pembelajaran hybrid. Penelitian ini bertujuan untuk menghasilkan model yang dapat memenuhi kebutuhan pembelajaran hybrid berbasis Moodle, melalui penelitian pengembangan (Research and Development/R&D) yaitu membangun model pembelajaran yang tepat melalui aplikasi “Brilian”. Uji model Critical Creative Hybrid Independent Learning (C-CHIL) dilakukan terkait (1) kualitas yang meliputi konten dan konstruk model dan (2) kelayakan. Uji validitas dilakukan oleh tiga orang pakar bidang pembelajaran menggunakan instrument angket dengan skala linkert 1-4. Hasil uji model C-CHIL menunjukkan bahwa (1) Uji validitas Konten: rata-rata 3.73 yang berarti sangat valid (2) Uji kelayakan rata-rata 3.63 yang berarti juga sangat valid. Dengan demikian dapat disimpulkan bahwa model C-CHIL memenuhi syarat valid (konten dan konstruk), dan layak digunakan mahasiswa berdasar pendapat pakar. Implikasi dari hasil penelitian ini adalah bahwa model C-CHIL dapat digunakan untuk meningkatkan kemampuan berpikir kritis, kreatif, dan mandiri terkhusus pada mata kuliah Matematika Lanjut di Perguruan Tinggi.

**Kata kunci:** Berpikir kreatif; berpikir kritis; masyarakat 5.0; matematika tingkat lanjut; pembelajaran mandiri.



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## INTRODUCTION

The concept of the industrial revolution starting from 4.0 and then growing to 5.0 certainly affects the world of education. The world of education must seriously consider the provisions given to students so that later when students complete their studies, they can adapt to conditions in society. Undeniably, the current conditions are filled with the availability of high technology in the form of automation, data exchange, Internet of Things (IoT), Big Data, and Artificial Intelligence. These current technologies have made the world change quickly, full of turmoil and uncertainty (Mkrtrchian et al., 2021). However, this has been solved by the presence of Society 5.0, which was first launched in Japan. Society 5.0 is expected to be a solution to the problems caused by the 4.0 and 5.0 Industrial Revolutions (Narvaez Rojas et al., 2021). The Industrial Revolution 4.0 uses artificial intelligence (AI), while Society 5.0 focuses on the human component. In Society 5.0, humans do not only become objects but play an active role as subjects who work with technology in achieving goals. Thus, with the advancement of technology, humans are not replaced, but humans play an active role in creating added value for welfare. This cannot happen automatically and requires a unique strategy. For humans to play an active role as expected in the era of Society 5.0, the part of the world of education to provide provisions for students is very important (Dewi et al., 2019; Pletz, 2021).

Why should the world of education seriously consider preparing its students to be ready to face Society 5.0? According to (Sinha & Sinha, 2020), one of the consequences of Society 5.0 is volatility, uncertainty,

complexity, and ambiguity (VUCA). The world of education must anticipate this because each element in VUCA is very influential in dealing with life (Firmansyah et al., 2021; Yusuf et al., 2020). (Sajidan et al., 2020) state that the important skills needed to adapt to Society 5.0 are problem solving, critical thinking, and creativity. Additionally, (Sudibjo et al., 2019) state that incorporating learner-centred learning is the most suitable approach to dealing with Society 5.0. However, educators should still guide students through project-based learning models and uses hybrid learning still. Meanwhile, (Aprilisa, 2020) states that ten skills must be introduced to students. The skills are: (1) the ability to think analytically, (2) the ability to think innovatively, (3) being active, (4) acquiring strategies in learning things independently and creatively, (5) critical thinking and analysis, (6) mastering technology and programming, (7) solving complex problems, (8) gaining leadership and the ability to adapt socially, (9) managing emotions, and (10) developing and analyzing problems.

In addition, the application of Society 5.0 is not only limited to the general public but also in the realm of religious-based education. For example, (Kholili, 2021) states that, in the world of Islamic religion-based education, students are also required to master technology, digital literacy, and digital ethics apart from moral education.

C-CHIL (Critical Creative Hybrid Independent Learning) is a learning model created to answer the challenges of the Society 5.0 era. This model was created to improve the quality of the process and learning outcomes of graduates and equip graduates to compete in the Society 5.0 period. 4C

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skills (Creative, Critical Thinking, Collaboration, and Communication) are needed. All of these skills will be achieved by students if students have been accustomed to thinking in High Order Thinking Skills (HOTS) and have applied Self Directed Learning (SDL) in their learning experience (Sudirman, 2022) (Nisa Azzahra; Tatang Herman, 2022). Then, students learn through the concept of Hybrid Learning using specific learning applications (Chaeruman et al., 2020; Demiral & Çepni, 2018; Jatmiko et al., 2018; Prayogi et al., 2018; Rusmansyah et al., 2019; Sajidan et al., 2020; Sudibjo et al., 2019). The C-CHIL Learning Model is designed to support learning in the new post-pandemic era, where there is the awareness that learning cannot only be done face-to-face. Educators and students are experiencing significant changes in how they teach and learn after the pandemic. People in the world of education have made many efforts in various ways (Simamora et al., 2020; Tuaycharoen, 2021).

The argument above reinforces the need to form the C-CHIL model to increase capabilities in the Society 5.0 era. Therefore, the primary purpose of this research is to build a C-CHIL model that meets the valid requirements in terms of content and constructs and is suitable for students to use based on expert opinion.

## **METHOD**

### **General Background**

The main objective of this research is to produce a quality C-CHIL model. The product in this research is the C-CHIL model in the form of a C-CHIL model book. This type of research is development research that adapts the research design of the Wademan model development

(Pandiangan, Gusti Made Sanjaya, 2017). The steps of the research model used are as follows: (1) Problem identification, (2) Identification of tentative products and design principles, (3) Tentative products and theories, (4) Prototyping and assessment of preliminary products and theories, and (5) Problem resolution and advancing theory (Nieven, McKenney, & Akker, 2007). To test the validity of the resulting model, the researcher uses experts. Experts validated the content and construction of the C-CHIL model draft and its feasibility for use by students. Content validity is the need for an intervention, and its design is based on current knowledge (Pandiangan, Gusti Made Sanjaya, 2017; Plomp & Nieveen, 2007) Construct validity is the fulfilment of a logically designed intervention (Pandiangan, Gusti Made Sanjaya, 2017; Plomp & Nieveen, 2007). The results of this expert assessment are used as a reference for revising the draft C-CHIL model.

The C-CHIL Learning Model will be applied to the Advanced Mathematics course in the Information Systems study program for 2<sup>nd</sup> semester students to familiarize students with using correct mathematical calculation techniques in solving everyday and business problems (Dewiyani Sunarto, 2020). As stated in the lesson plan or RPS, the Advanced Mathematics course has 3 Graduate Learning Outcomes (CPL), namely 1) Able to identify, formulate and solve problems of information needs of an organization, 2) Can communicate and work together effectively in a team, and has the character of lifelong independent learning, 3) Able to process and analyze large-scale data, both structured, semi-structured and unstructured data originating from within and outside the

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organization with various tools. Therefore, it becomes valuable information and knowledge in supporting decision making for the

management of an organization. Meanwhile, Course Learning Outcomes from advanced mathematics courses are as shown in the Table 1.

Table 1. Course learning outcomes for advanced mathematics courses.

CLO code	CLO Description	Element of learning	Bloom's level	Supported PLO
CLO – 01	Students can solve problems in everyday life or business using differential and integral techniques.	Cognitive	C4	PLO-01
CLO - 02	By using logic, students can state an opinion in a rational discussion.	Affective	A3	PLO - 02
CLO – 03	Students can use inductive logic to solve problems in daily life	Cognitive	C4	PLO-01
CLO – 04	Students can give suggestions to optimize a problem with boolean algebra, graphs, and trees	Cognitive	C5	PLO-03

In this study, a tool for teachers to implement the C-CHIL Learning Model is the “Brilian” application, built based on Moodle Learning Management System (LMS).

**Instruments and procedures of research**

This study used a questionnaire instrument for experts, which was adopted from (Pandiangan, Gusti Made Sanjaya, 2017; Plomp & Nieveen, 2007) The questionnaire consists of two parts, namely (1) a questionnaire to measure content validity and (2) a questionnaire to measure construct validity and model feasibility.

The procedures used in this study include (1) preliminary research, which was carried out to obtain related data: (a) ability-based learning outcomes in the Society 5.0 era, (b) Hybrid learning models, (c) factors that support learning, (d) the opinions of students and lecturers on learning. Furthermore, the next procedure is to (2) design the draft of the C-CHIL model, which includes formulating the syntax of the C-CHIL model, and (3) testing the validity and feasibility. In the end, we

(4) revise the C-CHIL model according to the test results.

**Data Analysis**

The collected data were analyzed using descriptive statistics. The statistics data was taken from the average questionnaire score, which experts had filled out as respondents. The criteria for the average score use the single measures interrater coefficient correlation (ICC) and Cronbach’s coefficient alpha (Pandiangan, Gusti Made Sanjaya, 2017) as shown in Table 2.

Table 2. Validity criteria for learning model

Score interval	Assessment Criteria	Explanation
3.30 < P ≤ 4.00	very valid	Usable without revision
2.30 < P ≤ 3.30	valid	Usable with minor revisions
1.80 < P ≤ 2.30	less valid	Usable with major revisions
1.00 < P ≤ 1.80	not valid	Unusable without revision and still requires consultation

Based on Table 2, the criterion is also used to analyze the quality of the C-CHIL model development.

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## RESULT AND DISCUSSION

According to the stages of research, the results of the research at the first stage, the researcher begins the activity by identifying the problem. At this stage, it was found that there were difficulties for students in achieving the learning objectives of the Advanced Mathematics course, especially to fulfill C4. Furthermore, the researchers identified solving the problem by building a prototype of the learning model product. The prototype model that was built was then adjusted to the supporting theories. In this third stage, the researcher explores several learning theories related to increasing the 4C. After the prototype model that has been built has been adapted to the learning theory, then the researcher conducts a validation test for learning experts to get input and suggestions for improvement. The results of the validation and expert advice are then used as a reference for the improvement of the developed learning model. In this study, the resulting product is a learning model that has not yet been tested on learning subjects (students).

### Model Development rationale of C-CHIL

The C-CHIL model was built based on 2 (two) basic things, namely (1) the theoretical rationale for the design of the learning model and (2) the objectives of developing the C-CHIL model.

Several learning theories support the development of the C-CHIL learning model, including the characteristics of learning in the Society 5.0 era, which consists of critical thinking concepts and creative and independent learning. All are outlined in the thinking framework, as shown in Figure 1.

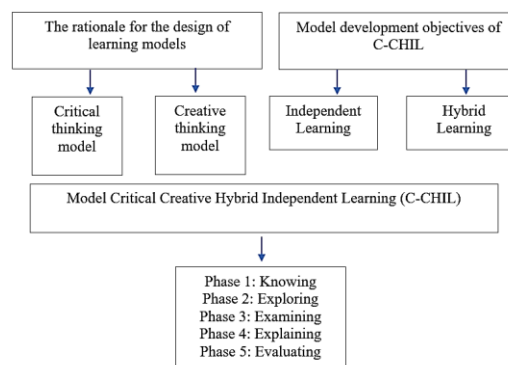


Figure 1. The rationality of C-CHIL model development

By combining the understanding of existing concepts, the five phases of the C-CHIL learning model are obtained, namely (1) Knowing, (2) Exploring, (3) Examining, (4) Explaining, and (5) Evaluating, in which each phase using the MoLearn learning application in its delivery.

The C-CHIL learning model divides time into 80% of students learning independently and studying with other students and 20% studying with educators (Benlahcene et al., 2020; Gonçalves & Capucha, 2020). From 80% of students who study independently and with other students, it is hoped that the skills needed in the Society 5.0 era, such as Independent Learning to overcome VUCA problems, and the ability to collaborate with other students, are very much required in the Society 5.0 era. It is hoped that with the many opportunities for students to read, do literacy, work in groups, and look for additional references, the skills needed in the Society 5.0 era can be honed well. Students also need the remaining 20% to meet directly with educators to get confirmation, conclude, and get a humane experience that may not be accommodated through any learning application.

To optimize 80% of independent learning and collaboration with fellow students, educators must be proficient at

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designing exciting teaching materials. It is because students will study independently and are equipped with (1) Semester Learning Plans, (2) Lecture Designs that contain details of tasks and things that students must do, (3) Student activity sheets, (4) Grid questions, (5) Evaluation. Educators must make all materials with the full awareness that everything is done per level and that students' understanding is gradual. Understanding the stages is crucial in increasing learning success with the C-CHIL model. The order in which the material is discussed, whether it is carried out directly by the teacher, or presented in teaching materials to be studied by students, becomes an important strategy.

There are five essential elements of learning model (Joyce, 2014). The five essential elements describe a learning model are: (1) syntax, a learning sequence commonly referred to as a phase. (2) Social system, namely the roles of students and educators and the norms that apply to them. (3) The principle of reaction provides an overview to educators about how to view and respond to what students are doing. (4) A support system, namely the conditions or requirements needed to implement a model, such as classroom settings, instructional systems, learning tools, learning facilities, and teaching media. (5) Instructional impact and accompaniment impact. Instructional impacts are learning outcomes that are achieved directly by directing students to the expected goals. In contrast, accompaniment impacts are other learning outcomes produced by a teaching and learning process. This creates a learning atmosphere experienced directly by students without direct direction from the educator.

Five important elements describing the C-CHIL learning model are described in the following sub-chapters.

### **1. Syntax of the C-CHIL Model**

In learning with the C-CHIL model, there are 5 phases: Knowing, Exploring, Examining, Explaining, and Evaluating. The description of the syntax and the skills that are trained are described as follows:

#### **Phase 1: Knowing**

This phase is the first phase when students start learning in a particular lesson; thus, this phase must be made so that students feel interested in the learning process they will undergo. This phase aims to attract students' interaction, focus, and attention. It also motivates them to play active learning roles (Khalil & Elkhider, 2016). In this phase, educators also introduce Brilliant as a Moodle-based learning application by asking students to find information about Moodle so that students begin to know how to do independent learning. This phase plays a vital role in the success of phases 2, 3, 4, and 5; therefore, educators must plan and execute this phase well.

#### **Phase 2: Exploring**

This phase aims to collect information with the help of Student Activity Sheets (LKPD) that educators have structurally made to train students' critical and creative thinking. The role of LKPD that is right on target has indeed been proven to be able to increase the goals to be achieved by educators (Bariyah, 2018; Simbolon et al., 2018; Wardani et al., 2018). Educators guide carrying out investigations/problem-solving step by step using society 5.0-based media/tools to seek explanations and solutions to

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train critical and creative thinking through scientific activities/investigations. Questions that introduce students to think critically should be done frequently at this stage. Guidance can be done in stages. If students feel that they are reliable, it is necessary to try them in independent/group project assignments without the advice of a lecturer to train Independent Learning.

**Phase 3: Examining**

This phase aims to guide students in analyzing, concluding, and discussing the assessment results. Critical and creative thinking skills can also be developed in this phase because students are encouraged to analyze data from assessment results to answer problems in phase 2. Through exploring a problem, students’ critical and creative thinking skills to solve problems will constantly be honed (Tanudjaya & Doorman, 2020)

**Phase 4: Explaining**

This phase aims to assist students in making conclusions and discussions of the results of investigations in various representations and to assist and guide students in planning, preparing,

and presenting work based on Society 5.0. Students’ independent learning abilities will be improved in this phase because students are encouraged to analyze data from investigation results to answer problems in phase 3. Through presentations, students will be trained to be able to express their thoughts and practice discussions using their critical and creative thinking skills (Koleva et al., 2018; Riadil, 2020).

**Phase 5: Evaluating**

This phase aims to evaluate the problem-solving process of scientific research activities/investigations based on Society 5.0. Educators see students’ work as evidence of learning and facilitate follow-up learning by providing advanced assignments that are carried out using the Brillian application as part of Hybrid Learning (Sajidan et al., 2020). If it is felt that students are reliable, it is necessary to try them in independent project assignments to train Independent Learning. Figure 3 shows the time allocation for the C-CHIL learning model. Teachers can use it as a guide when carrying out the learning process.

Table 3. Time allocation for syntax application of the C-CHIL model

Phase	Indicators	Time
1. Knowing	Independent Learning	20% of learning is done independently through the Brillian application
2. Exploring	Thinking creatively and Independent Learning	60% of the time is used for independent learning and communicating with other students
3. Examining	Thinking critically and Independent Learning	
4. Explaining	Thinking critically and creatively	20% of the time is used to learn with the teachers
5. Evaluating	Thinking critically and creatively	

From table 3, it can be seen that the syntax design of the C-CHIL Model allocates time for as many students as

possible to take on roles, namely by learning independently and discussing with friends or educators through the

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Moodle-based Brillian learning application. This is an application of the concept of active student learning, which has been widely used in education. The novelty of this learning model is combining the Hybrid Learning model with the skills training required in Society 5.0.

## 2. Result of the C-CHIL Assessment Model

The results of the C-CHIL model's quality assessment are shown in Table 4, which relates to the model's validity.

Table 4. The result of validity analysis of the C-CHIL model

	Validity Score	Scoring Criteria
<b>Content Validity</b>		
1. The needs of the C-CHIL learning model	3.80	Very Valid
2. State of the art of C-CHIL Model	3.67	
3. A Thinking framework of C-CHIL learning model	3.65	
4. Learning model description of C-CHIL	3.67	
<b>Construct Validity</b>		
1. The consistency of the C-CHIL learning model development	3.92	Very Valid
2. A thinking framework of the C-CHIL learning model	3.61	
3. Learning model description of C-CHIL	3.83	

Table 4 shows that the content validity of the C-CHIL model includes: (1) the need for the development of the C-CHIL model, (2) the state of the art of the C-CHIL model, (3) the framework for forming the C-CHIL model, and (4) The description of the C-CHIL learning model has an average validation score of 3.80, 3.67, 3.65, and 3.67 with very valid criteria. That means, according to experts, teachers can already use the C-CHIL learning model.

In addition, Table 4 also shows that the construct validity of the C-CHIL Model includes: (1) The consistency of the development of the C-CHIL Learning Model, (2) the framework for forming the C-CHIL Learning Model, and (3) the Description of the C-CHIL Learning Model has an average validation score of 3.92, 3.61, and 3.83 with very valid criteria. That means, according to experts, teachers can already use the C-CHIL learning model. Furthermore, to see the feasibility of the C-CHIL model, data has been obtained as in Table 5.

Table 5. Results of the analysis of the feasibility assessment of the C-CHIL model.

Advisability	Validity Score	Assessment criteria
1. The formulation of learning outcomes	3.50	Very valid
2. Clarity and conformity of syntax	3.89	
3. Clarity and relevance of supporting system	3.50	
4. Clarity and relevance of social system	3.58	
5. Clarity and ability reaction principle	3,67	



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Table 5 shows that after the feasibility test of the C-CHIL model has been carried out; it includes (1) the formulation of learning objectives, (2) the clarity and suitability of the syntax, (3) the clarity and relevance of the support system, (4) the clarity and interrelationship of the social system, and (5) the clarity of the social system. The ability of the principle of reaction has an average validation score of 3.50, 3.89, 3.50, 3.58, and 3.67, with very valid criteria. Thus, it implies that the C-CHIL Model can be applied in Higher Education, especially in Advanced Mathematics courses.

Another review with Cohen's Kappa (a metric often used to assess the agreement between two raters) was carried out to see whether the experts agreed with each other in assessing the quality of the feasibility of the C-CHIL model. This was done by looking at the agreement between experts. The results can be seen in Table 6(a).

Table 6a. Results of agreement between experts for quality of the feasibility

		Count		Total
		Assessor 2		
Assessor 1	SV	6	1	7
	V	1	5	6
<b>Total</b>		<b>7</b>	<b>6</b>	<b>13</b>

Table 6b. Result of symmetric measures

Symmetric Measures					
		Value	Asymptotic Standard Error <sup>a</sup>	Approximate T <sup>b</sup>	Approximate Significance
Measure of Agreement	Kappa	.690	.201	2.490	.013
N of Valid Cases		13			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

From the output in table 6b, Cohen's kappa coefficient value is 0.690. This means that there is an agreement between Jury 1 and Jury 2 regarding the assessment of the participants. The significance value can be seen in the Approx column. Sig. from the above output obtained a significance value of 0.013. Since the significance value is less than the significance level used at 5% ( $0.013 < 0.05$ ), reject the initial hypothesis so that it can be concluded that there is a significant agreement between assessors 1 and 2 at a significance level of 5%. It is expected that the Kappa value is close to one, indicating that Assessor 1 and Assessor 2 are consistent with each other.

In other result, the content validity also carried out to see whether the experts agreed with each other in assessing the quality of the content validity of the C-CHIL model. This was done by looking at the agreement between experts. The results Table 7a dan 7b.

Table 7a. Results of agreement between experts for content validity

		Count		Total
		Assessor 2		
Assessor 1	SV	9	0	9
	V	2	2	4
<b>Total</b>		<b>7</b>	<b>11</b>	<b>2</b>

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Table 7b. Result of symmetric measures

		Symmetric Measures			
		Value	Asymptotic Standard Error <sup>a</sup>	Approximate T <sup>b</sup>	Approximate Significance
Measure of Agreement	Kappa	.690	.201	2.490	.021
N of Valid Cases		13			

c. Not assuming the null hypothesis.

d. Using the asymptotic standard error assuming the null hypothesis.

From the output in table 7b, Cohen's kappa coefficient value is 0.581. This means that there is an agreement between Jury 1 and Jury 2 regarding the assessment of the participants. The significance value can be seen in the Approx column. Sig. from the above output obtained a significance value of 0.021. Since the significance value is less than the significance level used at 5% ( $0.021 < 0.05$ ), reject the initial hypothesis so that it can be concluded that there is a significant agreement between assessors 1 and 2 at a significance level of 5%. It is expected that the Kappa value is close to one, indicating that Assessor 1 and

Assessor 2 are consistent with each other.

Besides that, the construct validity also carried out to see whether the experts agreed with each other in assessing the quality of the content validity of the C-CHIL model. This was done by looking at the agreement between experts. The results can be seen in the Table 8a and 8b.

Table 8a. Results of Agreement between experts for Construct Validity

		Assesor 2		
		SV	V	Total
Assesor 1	SV	10	0	10
	V	1	1	2
<b>Total</b>		<b>11</b>	<b>1</b>	<b>12</b>

Table 8b. The result of symmetric value

		Symmetric Measures			
		Value	Asymptotic Standard Error <sup>a</sup>	Approximate T <sup>b</sup>	Approximate Significance
Measure of Agreement	Kappa	.625	.333	2.335	.020
N of Valid Cases		12			

e. Not assuming the null hypothesis.

f. Using the asymptotic standard error assuming the null hypothesis.

From the output in Table 8b, Cohen's kappa coefficient value is 0.625. This means that there is an agreement between Jury 1 and Jury 2 regarding the assessment of the participants. The significance value can be seen in the Approx column. Sig. from the above output obtained a significance value of 0.021. Since the significance value is less than the significance level used at 5% ( $0.020 < 0.05$ ), reject the initial hypothesis so that it can be concluded that there is a

significant agreement between assessors 1 and 2 at a significance level of 5%. It is expected that the Kappa value is close to one, indicating that Assessor 1 and Assessor 2 are consistent with each other.

### 3. Instructional Impact and Accompaniment Impact

The learning model is said to be effective if it can produce and achieve the goals set since the beginning of this

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learning model (Seel, 2017). The instructional impact of the C-CHIL learning model with this Brilliant application is that it can improve students' abilities in critical and creative thinking skills, as well as their independent learning abilities. The accompaniment impact obtained is showing initiation and persistence, showing responsibility, showing discipline and great curiosity, confidence and strong desire to learn, being able to organize time and set the pace of learning, showing love to learn and meet the planned target, and revision.

#### **4. Support System**

The support system for the C-CHIL learning model is all instruments, materials, and tools that can be used to implement the learning model using the Moodle-based Brilliant application. The support system for the C-CHIL learning model with the Brilliant application is the Syllabus, RPS, RPP, LKS, and Student Worksheets, as well as evaluation instruments to measure critical and creative thinking skills, as well as independence in learning. In addition, the Brilliant learning applications, all videos from various sources, and the internet network are a support system so that students can maximize their abilities to face the era of Society 5.0. This is intentionally conditioned because it supports Generation Z's need for technology-based learning (Sunarto, 2021a, 2021b)

#### **5. Social System**

The social system used is based on the Constructivism theory of Vygotsky (Akpan et al., 2020; Lasmawan & Budiarta, 2020). In this social system, relations between

students and educators are proclaimed and between students. In this C-CHIL learning model, it emphasizes on the ability of students to construct their knowledge and recognize the need for skills in the Society 5.0 era. Educators provide feedback so that students, through their learning activities, are able and accustomed to thinking critically and creatively and understand the importance of independence in learning. Students enjoy every stage in education because the feedback provided feels fun and makes students active. Unconsciously, through the problems given, students are trained in providing critical and creative problem-solving.

#### **6. Reaction Principle**

The principle of this reaction relates to how students interact with other students, including how students discuss with each other using critical and creative thinking and take advantage of the Brilliant learning applications that have been provided. The principle of the reaction is so important that it must be adequately planned (Roberts et al., 2010). In the C-CHIL model with the Brilliant application, educators use interaction to motivate students by employing educators emphasizing the importance of VUCA skills in the Society 5.0 era. In this learning model, critical and creative thinking are emphasized. Afterwards, educators provide appreciation, criticism, and other enlightenment to increase students' critical and creative thinking skills. Emphasis on students to be active, and not centred on educators, is forged through 60% of students learning independently and communicating with other students. At the same time, the remaining time is used with educators to have a better direction.

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## **7. Advantages of C-CHIL Learning Model with Learning Applications.**

The learning model developed based on this theoretical study is expected to provide several benefits. It is an alternative if educators want to improve students' critical and creative thinking skills and train independent learning skills to be ready to face a new era and materials for developing other learning models. This learning model can support overcoming current challenges known as VUCA. In overcoming volatility, students have been accustomed to separating facts from opinions through critical thinking so that they can formulate thoughts objectively and precisely. Meanwhile, to overcome uncertainty, students are used to being open to alternative points because they are used to independent learning. In complex situations, students are accustomed to collecting facts from various sources exemplified by educators, as well as the results of independent literacy, to then consider and test solutions, with the habit of using critical thinking. To overcome uncertain (ambiguous) situations, students are accustomed to being asked questions or discussion materials through forums on the Brilliant Application so that they have the adaptability and accuracy in answering because of the agility of thinking formed from critical and creative thinking (Raghuramapatruni & Shanmukha, 2017).

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## **CONCLUSION AND SUGGESTION**

The C-CHIL learning model is supported by the Moodle-based Learning Application, which is named the Brillian. It can be used when hybrid learning has become a new habit in the world of education. This model aims to improve students' abilities in critical thinking, creative thinking, and independent learning through Hybrid Learning. The C-CHIL model has five phases, namely (1) recognizing, (2) exploring, (3) studying, (4) explaining, and (5) evaluating. Every phase is always used Brilliant application. Emphasis on the implementation of C-CHIL uses a composition of 20% of

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learning time to get to know and 80% of the time for independent learning. The results of the test on content and constructs show that the C-CHIL model is declared very valid. Furthermore, the feasibility test results also show that the C-CHIL model is reported to be very valid, so it can be said that the C-CHIL model meets the quality and is feasible to be applied in universities, especially in Advanced Mathematics courses in Higher Education.

Suggestions for the development of this research is to conduct a small trial and continue with a large trial in the Advanced Mathematics class. The results obtained are then measured for validity and effectiveness.

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