Cypriot Journal of Educational Sciences

Volume 17, Issue 5, (2022) 1549-1566

www.cjes.eu

Design clarity learning model to improve advanced clarification ability on physics courses

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Suggested Citation:

Saputro, S. D., Tukiran, T. & Supardi, Z. A. I. (2022). Design clarity learning model to improve advanced clarification ability on physics courses. *Cypriot Journal of Educational Science*. *17*(5), 1549-1566. https://doi.org/10.18844/cjes.v17i5.6788

Received from January 01, 2022; revised from April 22, 2022; accepted from May 16, 2022.

Abstract

Advanced clarification is an essential part of thinking skills relevant to students, which contains the ability evaluate, make decisions and make arguments. This ability is needed to prepare students to face the VUCA era. Clarity Learning Model (CLM) is a formulation of IBL, and the strengthening of reasoning abilities aims to improve advanced clarification abilities in physics courses. The purpose of this study is to test the validity and reliability of Clarity Learning Model. The method used in this study is a validation technique which is part of the research and development model. The results of this study are valid and reliable Clarity Learning Model as an instructional design to develop further clarification on critical thinking skills. This model is still valid and reliable as instructional design in theory and material substance. Clarity Learning Model needs to be empirically tested to determine the practicality and effectiveness of the learning model.

Keywords: Inquiry-based learning, reasoning, validation technique, advanced clarification, physics courses

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1. Introduction

The undergraduate program is oriented towards preparing students to become intellectuals and scientists ready to enter the world of work or create a professional workforce (Ministry Of Education and Culture, 2012; President of the Republic of Indonesia, 2012). Achieving professionalism in the workplace requires various abilities; one of them is critical thinking (Bassham & Wallace, 2013; Ennis, 2016; Facione & Gitten, 2016; Winch & Gingell, 2008). Critical thinking skills can optimize intellectual capacity to make the best decisions (Davies, 2015; Ennis, 2016). Thus, critical thinking skills need to be trained or taught professionally.

Ennis divides critical thinking skills into five taxonomies: basic clarification, basic support, inference, advanced clarification, and facilitation ability (Ennis, 2015). Advanced clarification is very relevant to be trained at higher education level. Having the ability to clarify further proves that students have deep mastery of the field of science being studied (Ministry Of Education and Culture, 2012). In addition, it also supports the achievement of learning objectives, namely the ability to make the best decisions based on various sources of information (President of the Republic of Indonesia, 2012).

Advanced clarification abilities need to be developed through learning physics courses. This course is one of the fields of science contained in science. Appropriate learning in the field of science in the twenty-first century includes Problem-Based Learning, Project-Based Learning, Inquiry-Based Learning (Dewi, 2020; Scott, 2015). Based on the learning objectives of the introductory physics course, Inquiry-Based Learning (IBL) is more appropriate to use than other learning models. IBL forms knowledge through scientific activities, starting from observations, data collection hypotheses, and conclusions (Arend, 2012b; Duke, 1990; Joyce, B., & Weil, 2009). In addition, IBL also contributes to improving critical thinking skills (Herawati et al., 2020; Irwanto et al., 2019; Prayogi & Verawati, 2020).

Based on the literature study, IBL only improves two indicators of advanced clarification (Ennis, 2015) among the seven indicators. Among them are indicators on evaluating definitions (Herawati et al., 2020; Irwanto et al., 2019; Maknun, 2020; Pursitasari, I. D. et al., 2020; Rahmi et al., 2019; Zain & Jumadi, 2018b). In comparison, the second indicator identifies assumptions that are not stated (Herawati et al., 2020; Irwanto et al., 2019; Maknun, 2020; Pursitasari et al., 2020). Thus, it is necessary to develop a new model by adapting the advantages of IBL to develop the seven indicators of advanced clarification ability.

The preliminary study results examined as many as 60 students in Unersity Of Trunojoyo Madura using a critical thinking ability test (Pradana et al., 2017). Advanced clarification obtained an average of 3.21, included in the very low category. Based on the analysis of the work results on the questions, students still had difficulty in making appropriate arguments to answer the questions. These results align with the previous research (Herunata et al., 2020; Pradana et al., 2017; Sumarni & Kadarwati, 2020).

The advanced clarification ability component emphasizes evaluating and making appropriate arguments. Factors that influence a person's argument are influenced by reasoning (Butcher et al., 2019; Konstantinidou & Macagno, 2013; Kuhn, 2018). Because someone's argument represents reasoning (Zenker, 2018; Baumtrog, 2017). In addition, reasoning ability cannot be separated in learning science. Through reasoning, someone will be careful in making decisions. (Lindahl & Lundin, 2016). Moreover, if the reasoning ability is improved, it will impact the quality of one's argument (Konstantinidou & Macagno, 2013).

The environment in learning models development is an essential factor determining the success of the goals set (Aunurahman, 2009). The current condition of the classroom and environment does not allow face-to-face meetings due to the Covid 19 pandemic. Therefore, distance learning is an important thing to study. The basis of distance learning is based on a circular by the government through the Ministry of Education and Culture number 1 of 2020 regarding the Prevention of the Spread of Coronavirus Disease (Covid-19) in Higher Education (Directorate general of higher education, 2020). However, the fact is that distance learning is not an easy activity. Many students' learning motivation decreases during the distance learning process (Dew et al., 2020; Hidayat & Wibawa, 2020).

1.1. Theoretical Framework

1.1.1 Advanced clarification ability

All countries in the world are facing a new era, namely VUCA with the acronym volatility, which is turbulence, uncertainty marked by uncertainty, the complexity of problems is getting more complex, and ambiguity or ambiguity of situations and conditions (Raghuramapatruni & Kosuri, 2017). In this era, a person is required to make decisions quickly based on facts (Guo & Cheng, 2019). Higher education is a printer of professional human resources (Ministry Of Education and Culture, 2012, 2012), so it is necessary to prepare students to face VUCA.

Critical thinking skills are helpful for solving problems in various situations, even new situations that have never happened before (Raghuramapatruni & Kosuri, 2017). Another benefit is the ability to think critically as a basis for making decisions correctly and accurately (Amelia et al., 2019). Moreover, the ability to think critically is the basic ability that needs to be trained as a provision to face the future that continues to experience dynamics due to advances in information technology (Chalkiadaki, 2018).

Ennis makes a taxonomy of critical thinking starting from basic clarification, basic inference, inference, advanced clarification, and additional skills (Ennis, 2015). Advanced clarification ability is related to the ability to evaluate an event or statement critically, and then it is necessary to make a decision and state the reasons (Ennis, 2015). The ability to reason and make judgments are needed in higher education learning (Facione & Gitten, 2016; Davies, 2015; Moore, 2010). Therefore, critical thinking advanced clarification abilities are relevant as the basis for research (Davies, 2015; Ministry Of Education and Culture; President of the Republic of Indonesia, 2012). This study aims to improve all indicators of critical thinking advanced clarification ability (Ennis, 2015).

1.1.2 Inquiry-Based Learning (IBL)

IBL is one of the learning models to train students' thinking skills (Arend, 2012). Critical thinking skills can be trained through inquiry learning (Suchman, 1968). IBL is proven to contribute to developing critical thinking skills in the field of science. The inquiry learning model can improve critical thinking skills in the biological sciences (Hwang & Chen, 2017; Fuad et al., 2017; Rahmi et al., 2019; Indarini Dwi Pursitasari et al., 2015; Muskita et al., 2020). Likewise, in the field of chemistry, both at the intermediate level (Wardani et al., 2017; Jainal & Yosephine Louise, 2019; Farah & Ayoubi, 2020) and college (Gupta et al., 2015;, Sönmez et al., 2019), strengthened in the field of physics (Irwanto et al., 2019; Maknun, 2020; Zain & Jumadi, 2018; Yuliska & Syafriani, 2019)

The inquiry learning model was developed not to ask for answers to a question but to familiarize students with uncovering answers through the interpretation of data obtained through investigation. Inquiry learning has a syntax consisting of five learning phases, as in table 1 (Arend, 2012b; Joyce et al., 2009). Phase 1 presentation of the problem situation contains a presentation of problems that aims to attract students to be motivated in learning. Phase 2 problem verification contains students being allowed to propose a problem related with the subject of study. The teacher verifies the suitability of the answer. Phase 3 hypothesis contains students making hypothesis. Phase 4 data collection and explanation contains students conducting experiments to test hypothesis and report experimental results. Phase 5 evaluation of the investigation process contains students evaluating each stage of learning.

1.1.3 Reasoning skills

Critical thinking skills are based on the ability to use reasoning to make appropriate explanations based on evidence (Ennis & Chattin, 2018; Halpern, 2014; McPeck, 2017; Siegel, 1998; Saputro et al., 2020). The main purpose of teaching science is to assist students in developing patterns of scientific reasoning (Lawson, 2006). Therefore, reasoning cannot be separated from the field of science because scientists need to use reasoning in making decisions (Lindahl & Lundin, 2016).

The benefits of reasoning are not only for making decisions but also for explaining those decisions to others (Butcher et al., 2019; Kuhn, 2018). The benefits of reasoning are not only for making decisions but also for explaining those decisions to others (Konstantinidou & Macagno, 2013). Both arguments are formed from induced and deductive reasoning (Falk & Brodsky, 2014). In addition to that, through reasoning, one can evaluate one's argument (Mercier & Landemore, 2012).

In the study of scientific reasoning abilities with as many as 82 subject teachers, the results showed that the reasoning of prospective science teachers was still included in the low category (Zulkipli et al., 2020). The credibility and reliability of the source are not fully owned by young people (Pilgrim et al., 2019). Based on the argumentation analysis of students aged 15-16 years, many students who directly use the available references have not been able to analyze the references; this shows that their reasoning ability is still low (Lindahl & Lundin, 2016). Thus, strengthening reasoning requires someone to make decisions and arguments to explain decisions.

Based on the constructivist social theory developed by Vygotsky, in order that reasoning can be developed to build arguments, it is necessary to start from discussions of everyday life (Resnick et al., 2015). Dialogue can be used as an aid to building an argument structure (Walton, 2014). The success of the method for growing reasoning is through the growth of the reflective, or metacognitive aspect of argumentation (Kuhn, 2018). Therefore, further clarification skills can be increased, which will be grown through strengthening reasoning through a dialogue process, reflective attitude, and student metacognition.

1.1.4 Distance learning

Distance learning is a form of learning between educators and students who are geographically in separated places. The nature and scope of which is mediated by various media and technologies (Jung & Richter, 2019; Sewart, 2014). The forms of the media in distance learning vary according to the developments of technology, ranging from posts, radio-TV, and interactive videos (Jung & Richter, 2019; Kentnor, 2015; Moore & Kearsley, 2012)

The form of distance learning can be done with online learning (Hartnett, 2016), or with other terms that are often used in distance learning, namely electronic learning or e-learning (Jung & Richter, 2019; Bork & Gunnarsdottir, 2001). The availability of Learning Management System (LMS) can be optimized to provide material content, detect capabilities, measure and organize goals (Hoq, 2020). Students involvement in online learning activities is a determinant of success in learning (Baber, 2020). Moreover, through experimental information technology that is familiar with the real conditions, it can be simulated through virtual experiments (Hashemipour et al., 2011). Practical practice can reduce the fear of going wrong (Onal & Onal, 2020).

Distance learning can be done synchronously, i.e., there are students and teachers in a virtual space together or streaming, or asynchronously, i.e., teachers and students are not in one virtual space (Skylar, 2009). The application of both synchronous and asynchronous methods is ideal because each student has a different learning speed (Offir & Bezalel, 2008). Thus, the role of interaction in distance learning should be prioritized in order to maintain the quality of learning

1.1.5 Learning Model Development

Learning model is one of educators' methods to achieve certain learning goals (Arend, 2008). Specifically, learning model aims to help students master information, come up with ideas, have skills, build ways of thinking, and the meaning of learning through their learning styles and it is arranged in careful and structured planning (Joyce et al., 2009). Another important factor in model development is facility factors such as classroom condition, material characteristics and learning environment (Aunurahman, 2009).

After studying the objective factors, learning design, and learning environment, the design of Clarity Learning Model (CLM) as a hypothetical model to improve the advanced clarification critical thinking ability is shown in Figure 1.

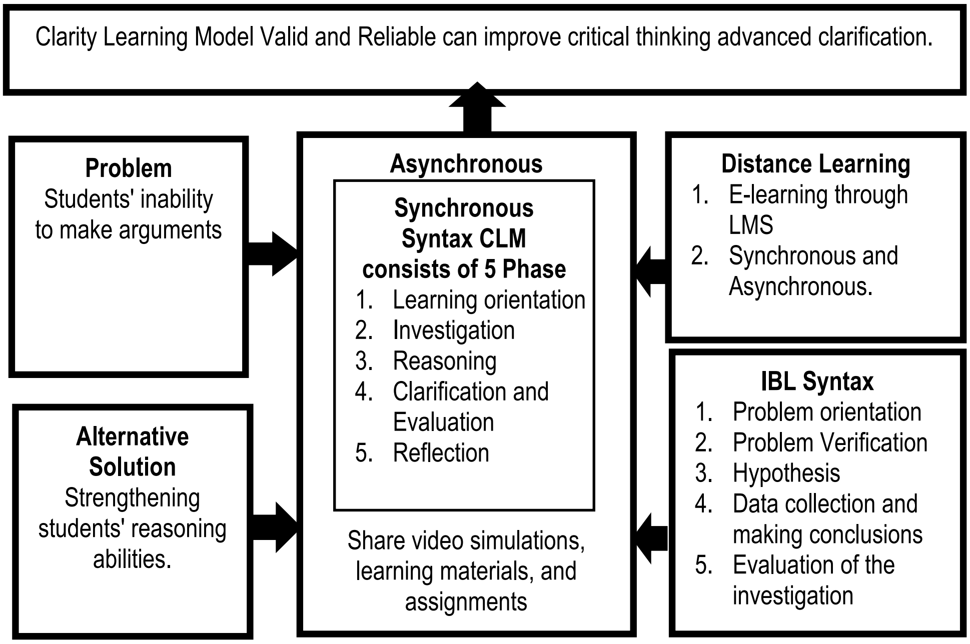

Figure 1. CLM as Hypothetical model to improving critical thinking advanced clarification ability

Based on Figure 1, CLM has a specific goal, that is to increase critical thinking ability for advanced clarification which includes seven indicators, namely judging definitions, using appropriate criteria, handling equivocation appropriately, attributing and judging unstated assumptions, thinking suppositionally, dealing with fallacy labels, metacognition, and proceeding in an orderly and reasonable manner appropriate to the situation. The learning design is developed from the optimization of IBL which produces a CLM syntax which consists of five phases, namely learning orientation, investigation, reasoning, clarification and evaluation, and reflection. The learning environment in CLM is a virtual classroom which is a characteristic of distance learning which consists of synchronous and asynchronous.

The development of CLM also concerns with the provisions of a learning model. The first is the factor of need and the recent knowledge (Plom & Nieveen, 2013). The second is the learning model components including having syntax consisting of the learning phase, social system, reaction principle, learning support system, and instructional impact and accompaniment impact (Joyce *et al.*, 2009). The three specific characteristics of the learning model are the logical theoretical rationale from its design, the learning objectives of the developed model, the teaching behaviours needed in order the learning can take place, and the learning environment needed to achieve the learning goals (Arend, 2008:7).

1.2. Related Research

So far, the inquiry learning model has contributed to the development of advanced clarification critical thinking ability. However, from the seven indicators in the advanced clarification components, only two were developed by inquiry learning. The first is assessing definition based on appropriate criteria (Irwanto *et al.*, 2018; Zain & Jumadi, 2018; Rahmi *et al.*, 2019; Herawati *et al.,* 2020; Maknun, 2020; Pursitasari *et al.*, 2020). The second indicator is identifying unstated assumptions (Irwanto *et al.*, 2018; Herawati *et al.*, 2020; Maknun, 2020; dan Pursitasari *et al.*, 2020).

Thereby, the inquiry model has not been able to fully develop the seven indicators of advanced clarification critical thinking ability. There is not yet a single specific learning model for developing the seven indicators in the advanced clarification components. The development of CLM can contribute to the world of education and science learning.

1.3. Purpose of the Study

The importance of advanced clarification critical thinking ability in higher education level as a professional character building. However, there is no single learning model that specifically improves advanced clarification. Therefore, this study aims to develop CLM to improve students' advanced clarification ability on physics courses.

2. Method and Materials

3.1 Research Model

The method used in this study is a validation technique which is part of the research and development model resulting in a learning design (Plom & Nieveen, 2013). The formation of the CLM model is still in the form of a theoretical concept, but has not been empirically tested. Therefore, to create the design that has been made can be valid before being used, this research design used a validation technique carried out through Focus Group Discussion activities (Akhdinirwanto et al., 2020). The flow of the validation technique is shown in Figure 2.

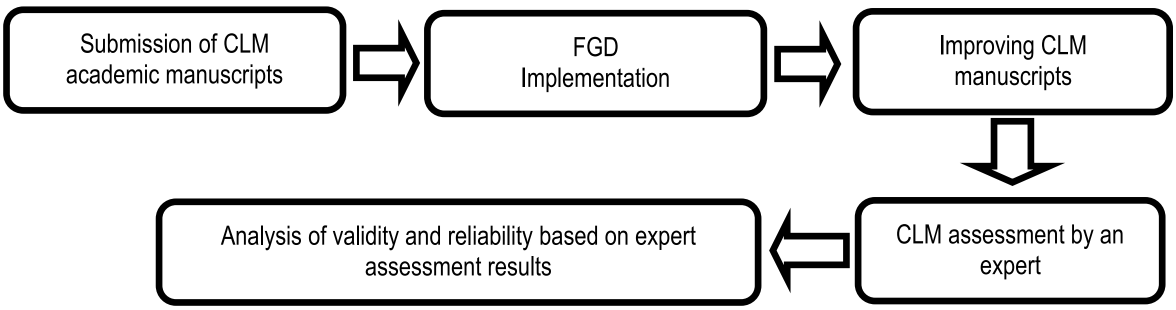

Figure 2. Stages of research implementation

The first step was sending CLM academic files to experts. Three experts were selected in the CLM assessment. One of them holds a professorship in physics learning, while the other two hold a doctorate in science learning. Two weeks before the FGD was held, the academic manuscripts had been sent via Google drive, which had been arranged in one folder.

The second step was the implementation of the FGD. Before the implementation of the FGD, after sending the academic files, an agreement was formed with the time and date of the FGD. The FGD was carried out online using the Zoom Meeting media. The FGD lasted for 90 minutes with a question-and-answer method. The FGD mechanism was that the CLM maker presented an academic paper in the form of a PPT for 20. Each expert was given 20 minutes to confront the academic text that had been made, and the developer directly answered what the expert asked. At the end of the activity, for the remaining 10 minutes, the developer submitted a summary of the results of the FGD.

The third step was repairing the CLM script. Developers improved all inputs given by the experts with a maximum period of two months. After being able to fulfil all the suggestions by the experts, the developer sent the repaired results to the experts via Google Drive. The developer informed the results of the improvement via WhatsApp.

The fourth step was the CLM assessment by the experts. The experts had received the CLM academic manuscript and validation sheet from the developer. For one week, the experts reviewed the results of the improvement and conducted an assessment based on the criteria contained in the CLM assessment sheet.

The fifth step was to analyze the validity and reliability based on the results of the CLM assessment. After one week, the developer actively asked the experts regarding the results of the CLM academic manuscript assessment. The recap of the results of the CLM assessment sheet was analyzed to calculate the validity and reliability of the CLM.

3.2 Participant

The product of this research was the formation of a CLM design that can improve advanced clarification. The CLM, which consists of 5 phases, was tested for its content and construct validity by three validators. The three validators are learning experts in the field of science.

3.3 Data collection tools

CLM validity was measured using a validation sheet consisting of content validity and CLM construct validity. The criteria that are measured in content validity include aspects of needs, aspects of state of the art, and model components (Plom & Nieveen, 2013). The details of the CLM content validity assessment are shown in Table 1.

Table 1. Aspects of CLM content validity

Aspect	Indicator
Need	1. 21st-century learning. 2. LUCA 3. KKNI learning achievements 4. Study program graduate profile.
State of the art knowledge	1. CLM Update 2. Study literature 3. Lesson planning 4. Learning environment

Aspect	Indicator
Learning components.	1. Special purpose 2. learning theory support 3. Activity guide 4. Social system 5. Reaction principle 6. Support facilities and infrastructure 7. Activities support the achievement of goals. 8. Accompaniment effect.

Construct validity is the development of a rational and logical structured model (Fikriyatii et al., 2022).The criteria measured in construct validity include an overview of the CLM model, aspects of the suitability of theoretical and empirical support, implementation and planning of learning, aspects of the learning environment, and aspects of assessment and evaluation (Plom & Nieveen, 2013). The details of construct validity are shown in Table 2.

Table 2. Aspects of CLM construct validity

Aspect	Indicator
CLM Overview	1. Congruence between the problem and the proposed solution 2. Goals CLM needs 3. Phases in CLM syntax support goal achievement
Theoretical and empirical support	1. Phase-1 correspondence with theoretical and empirical support 2. Phase-2 correspondence with theoretical and empirical support 3. Phase-3 correspondence with theoretical and empirical support 4. Phase-4 correspondence with theoretical and empirical support 5. Phase-5 correspondence with theoretical and empirical support
CLM implementation and planning	1. Phases in CLM contain logical, systematic, and consistent elements. 2. There is a relationship between the purpose of the material with the activity. 3. The existence of independent learning opportunities in CLM 4. There is easy access to teaching materials in CLM.
Learning environment	1. Facilities and infrastructure to support the achievement of CLM 2. The learning environment in CLM syntax can support learning objectives.
Assessment and evaluation	1. Assessment supports the achievement of goals. 2. Consistency of assessment and evaluation supports the achievement of objectives.

3.4 Data collection and analysis

The results of the validation of the three good experts used the CLM construct and content validity instrument. The evaluation of the validation sheet was based on improvements following the input in the FGD implementation. The content validity sheet was measured by three experts with four choices of quality entries, namely 1 (very poor), 2 (poor), 3 (good), and 4 (very good). The results of the assessments of the three experts were averaged, and then the categorization process was carried out based on the table. The model criteria were declared valid if the average score of the three experts was at least 2.60 (Akhdinirwanto et al., 2020; Ratumanan & Laurens, 2006).

Table 3. Evaluation of validity criteria

Interval Score	Assessment Category	Information
3.6 ≤ P ≤ 4	Very valid	It can be used without revision
2.6 ≤ P ≤ 3.5	Valid	It can be used with a little revision
1.6 ≤ P ≤ 2.5	Less valid	It can be used with a lot of revision
1 ≤ P ≤ 1.5	Invalid	It cannot be used and still requires consultation.

The CLM reliability calculation uses the following equation:

$$\text{Percentage of agreement} = \left[1 - \frac{A-B}{A+B}\right] x\ 100\%$$

The symbol (A) is the highest rating by the experts, while symbol (B) is the lowest assessment by the experts. Based on the calculation results, CLM can be categorized as reliable if it has a percentage of 75% (Akhdinirwanto et al., 2020; Borich, 1994).

3. Results

Three learning science experts assessed and commented on the CLM instructional design that had been developed. The validity assessed was in the form of content validity which contains aspects of model development needs, aspects of the state-of-the-art knowledge, and component aspects of learning models. In contrast, the construct validity assessed was the overview of the model, the suitability of the theoretical and empirical support, the implementation and design of the model, the learning environment, assessment, and evaluation. Table 4 shows the results of content validation and content of the CLM model.

Table 4. The results of content validation

Number	Aspect	Score average			Total Average	Criteria
		Expert-1	Expert-2	Expert-3		
1.	Need of model development	3.5	4	4	3.83	Very valid
2.	State of the art knowledge	3.75	3.75	4	3.83	Very valid
3.	Components of learning model	3.87	3.87	3.87	3.87	Very valid
4.	Average	3.75	3.87	3.93	3.85	Very valid
Percentage of agreement					97%	Reliable

Based on Table 5, the details of the content validity on the aspect of the need of model development have a total average of 3.83, which are categorized as very valid. State of the art knowledge has a total average of 3.83 categorized as very valid. The components of the learning model have a total average of 3.87, which are included in the very valid category. The results of all aspects of content validity that have been assessed by the experts with a total average of 3.85 are categorized as very valid (Akhdinirwanto et al., 2020; Ratumanan & Laurens, 2006). At the same time, the results of construct validation are shown in Table 5.

Table 5. The results of content validation

No	Aspect	Score average			Total Average	Criteria
		Expert-1	Expert-2	Expert-3		
1.	Overview of learning models	3.7	4	4	3.9	Very valid
2.	Appropriateness of	3.8	4	4	3.9	Very valid

No	Aspect	Score average Expert-1	Expert-2	Expert-3	Total Average	Criteria
	theoretical and empirical support					
3.	Implementation and planning of the learning model	3.75	3.75	3.75	3.75	Very valid
4.	Learning environment	3.5	4	4	3.83	Very valid
5.	Assessment and evaluation	4	4	4	4	Very valid
6.	Average	3.75	3.93	3.93	3.87	Very valid
percentage of agreement					97%	Reliabel

Based on Table 6, the details of construct validity in the overview of learning models have an average total of 3.89, which are included in the very valid category. Appropriateness of theoretical and empirical support has a total average of 3.93, which is included in the very valid category. The implementation and planning of the learning model have a total average of 3.75, which is included in the very valid category. The learning environment has a total average of 3.83, which is included in the very valid category. Assessment and evaluation have a total average of 4, which is included in the very valid category. The results of all aspects of construct validity that have been assessed by the experts with a total average of 3.87 are included in the very valid category (Akhdinirwanto et al., 2020; Ratumanan & Laurens, 2006).

4. Discussion

The validity of CLM was a stage of development research based on theory and problem analysis, both obtained through preliminary studies and literature studies. The CLM design developed in an academic paper was presented to the three validators to be assessed its validity level. The measured validity included content and construct validity.

Based on Table 4, the average validity of the content validity was included in the very valid category. Supported by the percentage of agreement reaching 97%, it was included in the reliable category. The content validity is the selection of relevant literature in model development (Fikriyatii *et al*., 2022). It means that the design of CLM, which includes aspects of learning needs, state of the art knowledge, and model components, uses relevant literature.

The aspects of learning needs on content validity were included in the very valid and reliable category. The fulfillment of this aspect was due to the learning objectives to train critical thinking ability for advanced clarification. Critical thinking ability can prepare students to work professionally (Bassham & Wallace, 2013;, Ennis, 2016;, Facione & Gitten, 2016;, Winch & Gingell, 2008), thus CLM supports the achievement of higher education learning goals (President of the Republic of Indonesia, 2012). Critical thinking ability can be used as the basis for making decisions appropriately and accurately (Amelia *et al*., 2019; Guo & Cheng, 2019), thereby it can prepare students to face the 21st century and the VUCA Era.

The state of the art knowledge aspect on the content validity was included in the very valid and reliable category. The fulfillment of this aspect was due to the fact that the design of the CLM contains a novelty of learning. Based on the study of the inquiry learning model as the basis for developing CLM, it was obtained that it was only used to measure two indicators. The first was defining terms and assessing definitions based on appropriate criteria (Irwanto *et al.*, 2018; Zain & Jumadi, 2018; Rahmi *et* *al.*, 2019; Herawati *et al.,* 2020; Maknun, 2020; Pursitasari *et al.*, 2020). The second indicator was identifying unstated assumptions (Irwanto *et al*., 2018; Herawati *et al*., 2020; Maknun, 2020; and Pursitasari *et al*., 2020). The CLM design measures seven advanced clarification indicators.

The components of the learning model aspect on content validity was included in the very valid and reliable category. This aspect was fulfilled because the CLM design met the criteria for the model development. The components of the learning model consisted of syntax which consisted of the learning phase, social system, reaction principle, learning support system, and instructional impact (Joyce et al., 2009) while the phases in the CLM syntax included learning orientation, investigation, reasoning, clarification and evaluation, and reflection. Social system was evidenced by group formation during the investigation phase. The principle of reaction was evidenced by the existence of question and answer activities in learning. The support system was in the form of the use LMS, virtual conference, and learning tools. The instructional impact was the strong concept of understanding physics and the ability to think critically for advanced clarification.

Besides measuring the content validity, the three validators also provided an assessment of the construct validity as shown in Table 5. The average of the construct validity was included in the very valid category. Supported by the percentage of agreement reaching 97%, which was included in the reliable category. Construct validity is the development of a rational and logical structured model (Fikriyatii et al., 2022). It means that the design of CLM which includes aspects of CLM overview, appropriateness of theoretical and empirical support, Implementation and planning of the learning model, assessment and evaluation was arranged rationally and logically.

The CLM overview aspect on construct validity was included in the very valid and reliable category. The fulfillment of this aspect was due to CLM's focus on achieving critical thinking ability. Through CLM learning, students are expected to have advanced clarification critical thinking ability thus they can meet learning target at the higher education level, that is being able to make decisions based on various sources of information (President of the Republic of Indonesia, 2012).

The theoretical support aspect on the construct validity was included in the very valid and reliable category. This aspect was fulfilled because the CLM design was based on learning theory and research evidence. Each phase of the CLM syntax has been supported by theoretical studies and empirical facts. Phase-1: Learning orientation. In this phase, students were presented with authentic problems, delivery of goals, and mutual agreement. This activity strengthened the problem presentation phase in the inquiry model (Arend, 2008). This phase was chosen based on previous research suggestions which stated that presenting authentic problems could provide a stimulus for critical thinking ability (Mundilarto & Ismoyo, 2017; Kadarwati 2020; Rahmi *et al*., 2019; Diani *et al*., 2020). The right step for students to construct knowledge is through an event (Ray, 2002; Chang, 2005). In cognitive theory, each given phenomenon will be responded through organizing the knowledge that has been possessed (schemata), which is called assimilation (Arend, 2008: 34; Moreno, 2010). The provision of information from the problem solving aims to achieve certain learning goals thus in order to maximally achieve the student goals, students make lesson plan which implements metacognitive theory (Moreno, 2010).

The design of the implementation of learning aspect, and the learning environment were included in the very valid and reliable category. This aspect was fulfilled because the CLM design can be carried out in two methods, namely synchronous and asynchronous. The CLM syntax which consisted of five phases was executed synchronously. Direct interaction will strengthen learning motivation (Anjana, 2018:16), and facilitate social factors possessed by each individual human being (Hartnett, 2016).

Learning tasks were carried out asynchronously facilitated by LMS. (LMS) as a medium for sending the results of reflection on action plans and mind mapping charts will streamline the learning process and objectives (Pratama *et al.*, 2020).

The assessment and evaluation aspect was included in the very valid and reliable category. The fulfillment of this aspect was due to the implementation of assessments to monitor the progress of the process and to improve the critical thinking ability for advanced clarification on an ongoing basis. In the phase 3 of reasoning, students did assignments independently and after doing the assignments they must fill out a difficulty poll in doing assignments independently using the available LMS. The results of filling out the poll were taken into consideration by the lecturers to give special emphasis to the indicators of critical thinking ability for advanced clarification which were still considered difficult during phase 4, namely clarification and evaluation. During the evaluation in phase 4, the lecturers also conducted an assessment as a form of confirmation of mastery of critical thinking ability after explanations and emphasis on the concept of advanced clarification components were made.

5. Conclusion

The CLM instructional design was developed to increase critical thinking advanced clarification ability based on the advantages of IBL clarification and strengthening reasoning. Determination through FGD has an impact on interactive communication between CLM developers and experts in science learning. This minimizes the double interpretation of the learning design. The improvement of the FGD results was in an increase in the quality of CLM development which was in the results of an expert assessment of CLM. The results of the expert assessment showed that the content-valid CLM had an average score of 3.85, which was included in the very valid category. CLM construct validity had an average score of 3.87 which was included in the very valid category. Meanwhile, the value of 0.96 was included in the reliable category. The CLM syntax included five phases, namely learning orientation, investigation, reasoning, clarification, evaluation, and reflection.

6. Limitation and Recommendation

However, the results of this study are still lacking in ideas that are systematically and logically based on the support of a literature review. For the findings of the CLM learning design to be able to determine the level of practicality and effectiveness in improving critical thinking, advanced clarification ability needs to be carried out in learning trials. So it can be concluded that CLM is feasible to be used as a learning design.

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