# A Conceptual Framework of the Ethno-Inquiry Learning Model and Its Validity to Support Pre-service Science Teachers' Critical Thinking Performance

Saiful Prayogi[1](✉), Sukainil Ahzan[1], Indriaturrahmi[2], and Joni Rokhmat[3]

[1] Physics Education, Universitas Pendidikan Mandalika, Mataram, Indonesia
saifulprayogi@undikma.ac.id
[2] Information Technology Education, Universitas Pendidikan Mandalika, Mataram, Indonesia
[3] Physics Education, Universitas Mataram, Mataram, Indonesia

**Abstract.** The purpose of this study is to create a conceptual framework for the ethno-inquiry learning model and determine its validity in supporting pre-service science teachers' critical thinking ability. The conceptual framework is constructed on an in-depth study of theoretical and empirical studies, information and literacy on pertinent topics dealing with critical thinking methodologies, inquiry studies, and ethno-science. Furthermore, it arose from the vision of an ethno-inquiry learning model, that is, an inquiry learning model connected with ethno-science to produce the critical thinking skills of pre-service teachers who teach science. The ethno-inquiry learning model was subsequently validated by five expert validators in a focus group discussion (FGD). The validity of the ethno-inquiry learning model was assessed by the validators in terms of content and constructs validity. The validation revealed that both the content and the construct of the ethno-inquiry learning model were pronounced very valid for supporting the critical thinking skills. The findings were then used to provide guidelines for adopting the model in the classroom.

**Keywords:** Ethno-Inquiry Learning Model · Conceptual Framework · Validity · Critical Thinking

## 1 Introduction

Critical thinking skills are influenced and closely related to the quality of learning in the classroom; when pedagogy is practiced effectively in the classroom and the learning process is oriented toward the achievement of critical thinking, it ensures the accomplishment of pre-service science teachers' critical thinking [1]. Finally, effective educational method interventions can be used to improve critical thinking performance [2]. In line with this, the modernization of effective and innovative learning systems needs to be encouraged to train preservice teachers' critical thinking [3–5]. The use of effective pedagogical strategies has a significant relationship with increasing preservice teachers'


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critical thinking [6]. Concerning science learning, a promising learning approach that is often used to train how preservice teachers think is inquiry learning. Inquiry is learning based on the principle of constructivism that places teachers as facilitators and students as active learners [7–9].

Some research have looked into the possibilities for training critical thinking through inquiry activities [10–12]. However, the papers also highlight flaws in inquiry learning, such as how complex logic in the discovery process may be for pupils [13]. Inadequate initial knowledge becomes an obstacle in implementing inquiry to train critical thinking [14]. Another report [15] is even more shocking, as students' critical thinking practices are unrelated to the teacher's inquiry strategy. Probably, it is assumed as the main factor causing problems shown by previous studies such as difficulties in practicing critical thinking aspects of the inference [16] dan evaluation [17] by applying inquiry learning. Finally, a new framework is needed toward the specific goal of supporting pre-service teachers" critical thinking performance.

In the context of science learning, the process of inquiry cannot be divorced from students' learning attitudes derived from the contexts and cultures in which they evolve and expand. It has even been proposed that scientific cognition reflects the local environment and culture [18]. On the one hand, critical thinking training is closely related to the presentation of a number of authentic problem contexts, so a learning method or model is a form of authentication from the environment or real life [19]. Critical thinking should begin with the diversity of social life, culture, local wisdom values, and customs in which pupils live, grow, and evolve. As a result, the introduction of science to develop students' critical thinking abilities begins with learning that is strongly tied to the values of local wisdom and culture [20]. Science in the cultural tradition or values of a nation's local wisdom is referred to as ethno-science [21]. In addition, to train thinking skills, learning by integrating ethno-science can foster students' sense of homeland [22], and of course, can lead to the formation of positive student characters to learn sciences.

The theoretical explanation, based on previous empirical investigations, is that inquiry learning design can be merged with ethno-science in order to develop students' critical thinking skills. It is the topic of our current study, where the major aim is to construct a conceptual framework for ethno-science-integrated inquiry learning--hereafter referred to as the ethno-inquiry learning model--to promote the critical thinking performance of preservice science teachers. As a learning model product with a novel framework, it is important to check the content and construct aspects in order to meet one of the rich product quality standards [23].

## 2 Method

This study is the first stage of development research that focuses on establishing the conceptual framework of the ethno-inquiry learning model and analyzing its validity to promote the critical thinking performance of preservice science teachers. The theoretical framework differs from the conceptual framework. The theoretical framework is produced using a deductive approach for literature review, whereas the conceptual framework is built using an inductive approach to produce a model-like framework [24]. The conceptual framework ultimately produces a hypothetical framework. In this study,

the conceptual framework is built based on an in-depth study of theoretical and empirical studies, based on information gathering and references on relevant studies on ways to train critical thinking, inquiry studies, and ethnoscience.

The conceptual framework document of the ethno-inquiry learning model developed is then validated. Ethno-inquiry is seen as a product of a new learning model. Therefore, it must meet the element of validity in accordance with the targeted objectives. Validity is the main requirement of a quality learning product [23]. The instrument for collecting data on the validity of the ethno-inquiry model is a validation sheet. The aspects of the validity of the ethno-inquiry model are focused on the content and construct. Therefore, the validation sheet designed and used to validate is the substance and structure validation sheet from the ethno-inquiry learning model. Content validity states that the content of the ethno-inquiry learning model refers to its development needs and the conceptual framework shows state-of-the-art of knowledge. Construct validity states the construct (concept) of the developed model. It leads to the consistency of the relationship between the components that make up the model and the supporting theories, and the logical construct of the learning model. Specifically, the validation instruments based on the aspects measured can be elaborated as follows.

(a) Content validity: Stating the content of the ethno-inquiry learning model refers to its development needs.
- Needs-01: There is an urgent need (urgency factor) to build a basic framework (based on empirical and theoretical studies) for the creation of the Ethno-Inquiry Model with the purpose of boosting preliminary science teachers' critical thinking capacity.
- Needs-02: The basic framework (based on empirical and theoretical studies) for the development of the Ethno-Inquiry Model is aimed specifically at improving preservice teachers' critical thinking performance to the demands of 21st-century global learning needs, learning needs in accordance with the Framework of Indonesian National Qualifications and National Standards Higher Education (SNPT).
- Needs-03: The Ethno-Inquiry paradigm results in learning characteristics based on the National Higher Education Standards (SNPT), where the learning process is meant to be holistic, encouraging the construction of an internalization of local and national wisdom which leads to a complete perspective.
- Needs-04: As one of the capital talent pools required and obtained in Indonesia's Merdeka Belajar Kampus Merdeka (MBKM) program, the Ethno-Inquiry Model can provide space to boost preservice teachers' critical thinking achievement.
- Needs-05: The Ethno-Inquiry Model was created to meet the prerequisites of science education in particular, which prioritizes the process of gaining knowledge through exploration activities on contextual challenges.
- Needs-06: Development of the Ethno-Inquiry Model provides an opportunity to bridge the gap between expectations for preservice teachers' learning needs to think critically. In fact, preservice teachers' critical thinking skills in science have not met expectations.

(b) Content validity: The conceptual framework of the ethno-inquiry learning model shows state-of-the-art (SoA) of knowledge.
- SoA-01: Development of the Ethno-Inquiry Model as a novel concept in scientific education to increase preservice teachers' critical thinking ability.

- SoA-02: The Model was developed as a guideline for enhancing the inquiry learning model in order to improve preservice teachers' critical thinking ability through the integration of ethnoscience with the inquiry process.
- SoA-03: Ethnoscience as a new framework to acquire knowledge adaptability process based on scientific phenomena that become apparent as traditions (local wisdom), where ethno-inquiry learning can theoretically restructure cognitive processes to encourage the development of a greater grasp of both the substance of the materials and the inquiry process itself.
- SoA-04: The Ethno-Inquiry Model was created using the theoretical and empirical foundation of a new reference source that describes each integrated model variable (ethnoscience, inquiry, ethno-inquiry) and its relationship to critical thinking.
- SoA-05: The Model learning step is considered as a new paradigm that has the ability to increase preservice teachers' critical thinking performance as a result of an intervention that integrates ethnoscience and scientific inquiry processes.

(c) Construct validity: Stating the unambiguous and reasonable of the construct (concept) of the developed model.

- Cons-01: The Ethno-Inquiry Model is based on consistent theoretical and empirical studies related to the purpose of developing the model for improving preservice teachers' critical thinking performance
- Cons-02: The learning phases in the Ethno-Inquiry Model show a logical sequence of learning activities
- Cons-03: The learning stages in the Ethno-Inquiry Model are consistently related to the learning process based on scientific inquiry activities.
- Cons-04: Learning activities are related to the phases of inquiry learning which shows logical activities integrated with ethnoscience

Technically, the validation process is carried out through a focus group discussion (FGD) mechanism. 5 validators are employed to validate the ethno-inquiry learning model. Researchers chose validators with criteria. They are professionals in the field of teaching and research in the last 10 years, and have experience in developing or implementing learning models related to aspects of critical thinking and inquiry.

Each statement item regarding the validity of the model (content and construct) is given a score in the range of 1 to 5. The validators gave the appropriate score according to their perception of knowledge and experience which is certainly related to the framework of developing the ethno-inquiry model. The data from the validation of the ethno-inquiry model are analyzed descriptively and concluded with its validity trend. This is according to the following criteria: very valid ($x > 4.21$), valid ($3.40 < x < 4.21$), moderately valid ($2.60 < x < 3.40$), less valid ($1.79 < x < 2.60$), and invalid ($x < 1.79$) [14]. In addition to providing a validity score, the validators also provide suggestions for improvement on the prepared validation sheet. Researchers accommodate appropriate or relevant suggestions to improve and refine the developed ethno-inquiry learning model.

# 3 Results and Discussion

## 3.1 Conceptual Framework of Ethno-Inquiry Learning Model

A learning experience in an authentic environment is a characteristic of inquiry, and authentic learning is based on the existence of a social, cultural, customary, and local wisdom environment where a learner grows and develops. Opportunities to create critical thinking through scientific inquiry become increasingly open when the inquiry process is linked to the context of knowledge of culture and customs. Ethno-science refers to the knowledge brimming by a nation or ethnic group based on the wisdom values embodied within it. In connection with the current study, the conceptual framework of the ethno-inquiry learning model is built based on scientific inquiry activities that are integrated with ethno-science.

In general, the ethno-inquiry learning paradigm allows pre-service teachers to examine (in depth) local culture values related to science, and the problems in it can be handled using scientific concepts. This process becomes a critical thinking drilling process for pre-service teachers. A comprehensive, hypothetical model showing the conceptual design of the ethno-inquiry is presented in Fig. 1. It is adapted from the learning model development framework of Novitra et al. (2021) which is elaborated on the framework of Joyce et al. (2009) where the structure of the learning model is characterized by syntax (phases or steps), social system (social system), principles of reaction (principle of reaction), support system (support system), and effects of the model (impact of the model). The learning phase of the ethno-inquiry model that supports the performance of critical thinking skills in students is presented in Table 1.

When viewed in the learning phase, the identity of the ethno-inquiry model that distinguishes it from other inquiry models can be seen from several aspects, namely: (a) The five-step construction that is integrated and inherent between one another. This is a new phase that is not found in the inquiry model developed in previous studies. (b) The ethnoscience context is attached to each learning phase. As far as exploration and empirical studies have been carried out, there is no construction of an inquiry model (or its development) that places ethnoscience attributions in each phase and process of inquiry learning. This is a new identity in the learning phase and process that is not found in the inquiry model developed in other studies. (c) Encouraging pre-service teachers to consider scientific discoveries that have evolved into cultural traditions and local wisdom (ethno-reflection) is placed in the second phase of the ethno-inquiry model. This is interesting and something new because reflection is usually placed in the last phase of inquiry learning. (d) The identity of the ethno-inquiry model is intended to train, develop, or improve critical thinking skills.

## 3.2 Validity of Ethno-Inquiry Learning Model

The measure of the validity of the ethno-inquiry model is from the aspect of content and construct. Through the FGD mechanism, the two aspects have been assessed by five validators. The results of the validation of the ethno-inquiry learning model are summarized in Table 2 and Table 3.

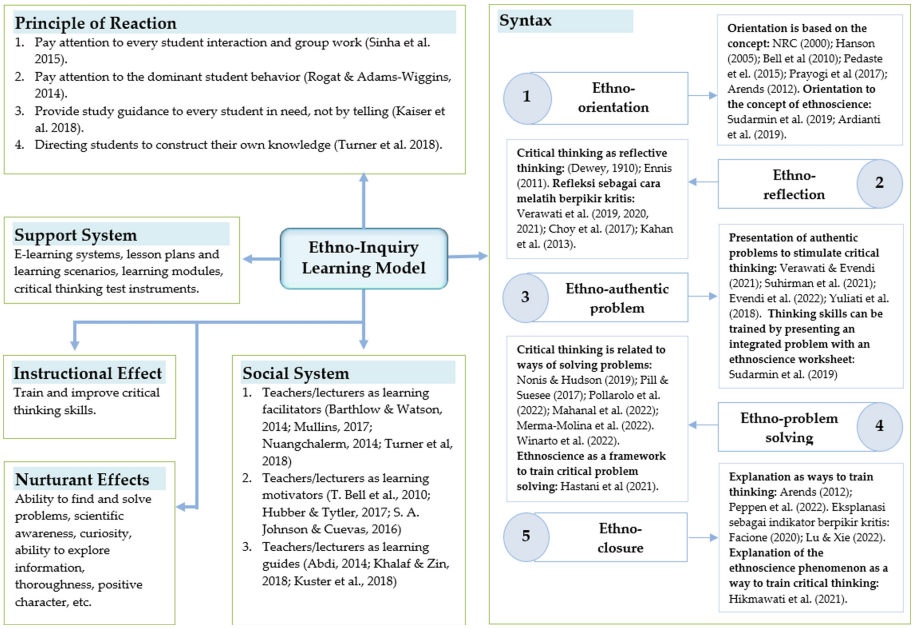


**Fig. 1.** Conceptual design of the ethno-inquiry learning model

**Table 1.** Teaching steps of ethno-inquiry learning model

| Learning Phases | Description of learning processes |
|---|---|
| 1. Ethno-orientation | • Prepare preservice teachers for learning, convey the objectives or competencies to be achieved, and introduce the concept of ethnoscience |
| 2. Ethno-reflection | • Invite students to reflect on specific ethno-science phenomena that become cultural traditions and local wisdom related to learning materials |
| 3. Ethno-authentic problem | • In-depth discussion related to the phenomenon of ethnoscience as an indigenous science and identify specific problems associated with learning materials |
| 4. Ethno-problem solving | • Conducting ethnoscience problem solving with experimental or analytical methods that support problem solving, and presenting scientific explanations of ethnoscience problems |
| 5. Ethno-closure explanation | • Closing the lesson with a final explanation (conclusion) on ethnoscience phenomena related to the material. |

A learning process requires the support of a valid conceptual framework from the model applied in the learning [11, 27], including instruments to support the learning process [28]. Therefore, each conceptual framework of a new learning model developed must be tested for validity. Specific to the achievement of critical thinking, previous

**Table 2.** The results of the ethno-inquiry learning model validation

| Aspect | Mean Score | Std. Error | Std. Dev. |
|---|---|---|---|
| Content validity (needs-01) | 4.80 | .200 | .447 |
| Content validity (needs-02) | 4.40 | .245 | .547 |
| Content validity (needs-03) | 4.80 | .200 | .447 |
| Content validity (needs-04) | 4.80 | .200 | .447 |
| Content validity (needs-05) | 4.60 | .245 | .547 |
| Content validity (needs-06) | 4.20 | .200 | .447 |
| Content validity (SoA-01) | 5.00 | .000 | .000 |
| Content validity (SoA-02) | 4.40 | .245 | .547 |
| Content validity (SoA-03) | 4.60 | .245 | .547 |
| Content validity (SoA-04) | 4.40 | .245 | .547 |
| Content validity (SoA-05) | 4.80 | .200 | .447 |
| Construct validity (Cons-01) | 4.80 | .200 | .447 |
| Construct validity (Cons-02) | 4.40 | .245 | .547 |
| Construct validity (Cons-03) | 4.60 | .245 | .547 |
| Construct validity (Cons-04) | 4.60 | .245 | .547 |

**Table 3.** The average score of the validity aspect of the ethno-inquiry model and its validity criteria

| Validity aspects | | Min. | Max. | Mean | Std. Error | Std. Dev. | Criteria |
|---|---|---|---|---|---|---|---|
| Content | Needs | 4.17 | 5.00 | 4.60 | .144 | .323 | Very valid |
| | State-of-the-art | 4.20 | 5.00 | 4.64 | .133 | .297 | Very valid |
| Construct | Consistently & logically | 4.25 | 5.00 | 4.60 | .150 | .335 | Very valid |

studies [14] show that a valid learning model in the aspect of content and construct validity has become a supporter of the achievement of preservice teachers' teaching critical thinking.

In the current study, the conceptual framework of the Ethno-Inquiry learning model has been built and further validated through the FGD mechanism (results see Table 2 and Table 3). The need factor in the targeted content validity aspect is the need based on global and national demands. In the aspect of content validity, the conceptual framework of the ethno-inquiry learning model has reflected the need for factors in its development, namely for the purpose of improving preservice teachers' critical thinking skills as the demands of 21st-era worldwide learning demand, learning needs in accordance with the Indonesian National Qualifications Framework, and National Standards of Higher Education (SNPT). The ethno-inquiry learning model has led to the characteristics of

learning according to the SNPT, where the characteristics of the learning process are expected to be holistic which concurs with the establishment of a global worldview by comprehending both the local and national wisdom. In addition, the ethno-inquiry learning model can provide space to support the achievement of preservice teachers' critical thinking as one of the capital talent pools needed and achieved in the "Merdeka Merdeka Kampus Merdeka" (MBKM) program in Indonesia. In essence, the development of the ethno-inquiry learning model provides an opportunity to bridge the gap between expectations for the preservice teachers' learning needs to think critically and the fact that learners' critical thinking skills in science still do not meet expectations. The content validity score of the need aspect is 4.60 with very valid criteria (very valid if, $x > 4.21$).

Content validity of the state-of-the-art aspect shows that the development of the ethno-inquiry model as a new idea in the context of teaching science is oriented to improve preservice teachers' critical thinking performance. It is also as a recommendation for improving the inquiry learning model with the specific aim of improving preservice teachers' critical thinking performance by integrating ethnoscience with the inquiry process. The ethno-inquiry learning model is a form of ethno-science intervention in inquiry as a new paradigm of knowledge transferability processes based on scientific entities that develop as culture (local wisdom), where ethno-inquiry learning can theoretically restructure cognitive processes to encourage the development of a better understanding of material content and the inquiry process itself. In relation to the novelty of the theory, the development of ethno-inquiry learning is based on the background of the theoretical and empirical studies from new sources that describe each integrated model variable (ethnoscience, inquiry, ethno-inquiry), and its relation to critical thinking. The content validity score of the state-of-the-art aspect is 4.64 with very valid criteria (very valid if, $x > 4.21$).

Finally, the aspect of construct validity identifies the ethno-inquiry learning model with its level of consistency and logic. The validation results show that the learning model has been compiled based on theoretical and empirical studies that are in line with the goal of developing the model in improving preservice teachers' critical thinking performance. The learning phases in the ethno-inquiry learning model show a logical sequence of learning activities, and are consistently related to the learning process based on scientific inquiry activities. In addition, the learning process is associated with the phases of inquiry learning which shows logical activities that are integrated with ethnoscience. In the aspect of construct validity, the validity score of the ethno-inquiry learning model is 4.60 with very valid criteria (very valid if, $x > 4.21$).

The validity of a model or learning method in terms of content and construct becomes a benchmark for its implementation in the classroom [30, p.], and guarantees the achievement of the expected learning objectives [27]. Overall, the validation results show that the Ethno-Inquiry learning model has been declared very valid. Referring to these results, the Ethno-Inquiry learning model is feasible to be implemented in the classroom for the purpose of training and improving the performance of preservice science teachers' critical thinking skills.

## 4 Conclusion

Ethno-inquiry is an inquiry learning model that is integrated with ethno-science and seeks at cultivating a knack for critical thinking of pre-service science teachers. The conceptual framework is built on an in-depth study of theoretical and empirical studies, based on information gathering and literacy on relevant studies on ways to train critical thinking, inquiry studies and ethno-science. The ethno-inquiry model's learning stages comprises ethno-orientation, ethno-reflection, ethno-authentic problem, ethno-problem solving, and ethno-closure explanation. The ethno-inquiry learning model has been validated through the FGD mechanism. The result shows that the ethno-inquiry learning model is very valid in terms of both content and construct: the goal of strengthening pre-service teachers' critical thinking skills. This result becomes a reference for its empirical implementation in the classroom.

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