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# An Overview: Inquiry Based Science Learning Models in Empowering Creative Thinking Skills High School Student

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## ABSTRACT

Creative thinking skills are low due to media, non-specific learning models, learning activities are limited to the inability to accommodate creative thinking. The model offered is a Science-based inquiry model. The aim is to analyze the level of the syntactic Wenning (LoI) of the same, the potential for Investigative Learning in empowering creative thinking skills through study of literature. Its method with descriptive qualitative inductive pattern analysis techniques. Based on an analysis of 67 articles from 2007-2020, that Inquiry Learning empowers creative thinking skills, science learning activities in joint scientific work in each syntax becomes an important argument in the development of inquiry learning models. The importance of confrontation issues is to explore students' ideas from unusual things before observational activities can be met, collect data and verify on smoothness, flexibility, elaboration and redefinition abilities; collect data for testing hypotheses about originality and flexibility; organize and formulate explanations for the smoothness, flexibility, elaboration and analysis of the investigation process regarding elaboration. Implementation of Inquiry Learning has the potential to explore original ideas through problems, although not yet an indicator of creative thought that can be accommodated, the offer to change the syntax of Inquiry studies at the stage of confrontation is very important.

**Keywords:** Creative Thinking Skills, Inquiry, Science Learning, Study of Literature.

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## INTRODUCTION

21st Century science learning is designed with a higher-order thinking approach (Higher Order Thinking Skills) to overcome global problems and be able to understand science through the process of discovery [1], [2]. One of high-level thinking is creative thinking skills. Science learning not yet contextual in life activity (A. Khoiri, Sunarno, Sajidan, & Sukarmin, 2019; A. Khoiri & Sunarno, 2019; Sumarta, 2017). Creative in original ideas so achieved to adapt to conditions different, flexible thinking, be creative, think critically, respect the community and be tolerant of ideas. The purpose of

science education is very relevant with Number 24 concerning basic competencies of high school physics lessons regarding core competencies in the aspect of skills.

Science as a body of knowledge is formed and obtained through a process of inquiry [1], [6]. The science-based learning process of discovery as a 21st-century demand [7], [8]. The discovery process recommended by the 2013 Curriculum is Inquiry-based science learning. One of the Inquiry Levels is Inquiry Lesson where the teacher should show the scientific process explicitly to students to understand how to formulate scientific activities with direct guidance from the teacher [9], [10]. The teacher's scientific process not only requires scientific ability but also the ability to develop appropriate learning to support learning. Science as a process is nothing but a scientific method [1], [6].

Inquiry-oriented science learning has three characteristics: First, positioning students as learning subjects that emphasize discovery activities and the teacher as a facilitator. Second, learning activities through question and answer to emphasize students asking questions. Third, developing the ability to think creatively through the mental processes of students [6], [10]–[12]. Relevant to the 2013 curriculum recommended model is inquiry-based learning beginning with inquiry lesson [10], [13].

The level of inquiry is determined by the activities of the teacher and students in involving intellectual intelligence and the controller. If teacher activities are more active than students, the level of inquiry is low and vice versa for Creative thinking (A. Khoiri et al., 2019; A. Khoiri & Sunarno, 2019; Türkmen, 2015) which are cognitive activities in finding solutions to problem-solving [15], as well as finding ideas to solve these problems [16].

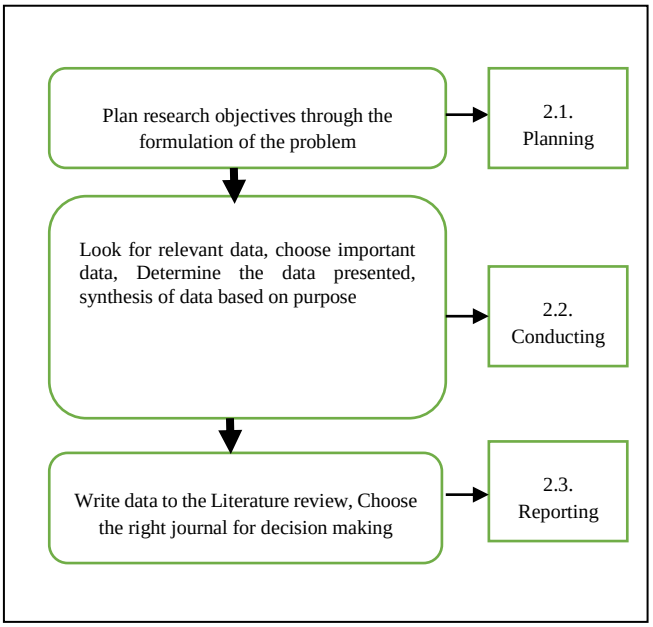
The low creative thinking triggered by some teachers only done individually [17] The teacher does not know to developed process learning [18]. The learning approach is difficult for limited creative thinking and knowledge [11].

Based on consideration of research problems, the need for solutions in Inquiry Learning that can facilitate convergent thinking as a creative thinking process, to try out students' curiosity, make observations, make conclusions and gain experience through scientific processes.

## MATERIALS AND METHODS

This type of literature study research approach [19]. The steps used in the study can be presented (figure 1). A Literature review as a scientific process governed by completeness, ambiguity and agreement. In the review of the researchers, most of the studies used qualitative data. Literature Review consists of: Planning, Conducting, and Reporting. Details of each stage as shown below:

**Figure 1.** Literature Review Process




**Planning**

A paper should have a short, straightforward title directed at general readers in no more than 20 words. Research Question (RQ) for the initial and basic part of an literature review. RQ is used to guide the process of searching and extracting the inquiry lesson literature model and creative thinking. Analysis and synthesis of data, as a result of the literature review is the answer to the RQ that we set before. A good RQ is a useful, measurable, direction towards understanding state-of-the-art research from inquiry lessons and creative thinking.

**Conducting**

Stages of conducting the implementation of the literature review. in accordance with the Literature Review Protocol that we have specified. Starting from determining the literature search keywords, Subject namely Creative Thinking, Inquiry and Science Education from 2010-2020.

**Reporting**

Reporting is the stage of writing Literature Review results beginning with the inclusion criteria of the objective to determine the search for journal sources or other sources that can be accounted for namely: Science direct, Google scholar, Research gate, and Elsevier with manual research, then filtering or filtering sources that are relevant to the criteria of research studies, if not relevant is not continued search, if relevant is reviewed and mapped based on research objectives. Furthermore, the findings of the literature study are synthesized and provide conclusions or recommendations for further research.

The systematic review inquiry lesson model as a solution so that students are trained in scientific work and directly involved. Students not only know about the material but students also really understand the learning material so that later they can deliver the material. In addition, a

series of inquiry activities can train students to not focus on only one answer or method of solving the problem encountered. But by bringing up many alternative answers to the problem solving on indicators of creative thinking skills [20] The objectives literature studys explained through learning, the potential of Inquiry lesson models in empowering creative thinking skills and the linkages of the Model Inquiry Lesson component with the indicator of creative thinking skills [14].

**Potential Inquiry Lesson Models in Empowering Creative Thinking Skills**

**Inquiry Level Model**

The experiential towards increasing scientific literacy [21]–[23]. Teaching theory must be more closely related to the desired results [16], [24]. The best way to make students more scientific is through the process of learning experiences, asking students to study science by imitating the work of scientists. [25] students will accept impulses, make observations, draw conclusions from observations, and make judgments.

Students will complete another learning cycle triggered by new encouragement [26], [27]. Scientific and intellectual process skills through scientific processes are expressed in inquiry cycles with different levels that have the same syntax. The inquiry learning model that can be applied is the levels of inquiry (LOI) [13], [28]. The LOI learning model presents an explicit hierarchical framework for inquiry-oriented teaching and learning activities. [9] LOI is an inquiry learning that will gradually train students' abilities, moving from basic level thinking to higher-level thinking, where the learning center gradually shifts from teacher to student [29]–[31].

The importance of meta-analysis in mapping the implementation of inquiry-based science learning in Indonesia which shows the potential for development can integrate with approaches, methods or other learning techniques, so as to maximize learning outcomes. Show that avaredge 43.67 in the poor category for creative student high school. Research [17] also shows the average Klaten Regency with a high category of 28.66% and high schools with a low category of 13.71% in creative students. Furthermore [6] that student creativity is exacerbated from the 43.56% test results in the low category.

The inquiry learning model is learning that fits the scientific approach because it can encourage students to find concepts through discovery. Discovery activities through scientific processes to solve problems [10], [15], [32]. It also can draw conclusions, and produce predictions that make students actively involved in learning through student-centered activities [4], [9], [32]. According to Carl J. Wenning the level of inquiry [10] presented in Table 1.

**Table 1.** Level of Inquiry [10]

| Level Inquiry | Main Pedagogical Objectives |
|---|---|
| Discovery Learning | Active student involvement in finding knowledge |
| Interactive Demonstrations | Dealing with prior knowledge |
| Inquiry Lessons | Cooperative work used to build more knowledge |
| Inquiry labs | Collaborative work used to detailed knowledge |
| Real-world Applications | Cooperatives and collaborative groups using project-based & problematic approaches. |
| Hypothetical inquiry | Experience more realistic forms of science |

Inquiry lesson learning model is activities oriented to the inquiry process to find concepts that are directed at scientific experiment activities with direct guidance from the teacher helping students formulate and identify through an experimental approach independently [1], [10], [13] The syntax in the inquiry lesson learning model The level of the Science Learning Model is based on experience towards increasing scientific literacy [21]. Teaching theory must be more closely related to desired outcomes [16], [24]. The best way to make students more scientific is through the process of learning experiences, asking students to study science by imitating the work of scientists. [25], [33]. Students will finish the cycle Other learning that is triggered by new encouragement [26], [27], [34] in Figure 2.

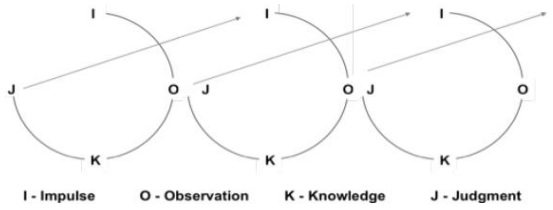



**Figure 2.** Systematic Review Process Model of Experiential Learning [13], [27], [33]

Scientific and intellectual process skills through scientific processes expressed in the cycle of inquiry with different levels have the same syntax in Figure 3.

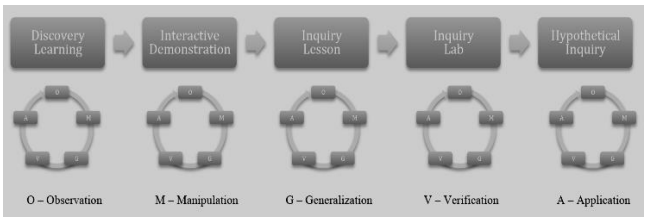



**Figure 3.** Five levels of inquiry by [13]

Related to inquiry learning, an inquiry which is a level of inquiry (LOI) [13]. The inquiry level is determined based on intellectual intelligence and the controller. Intellectual intelligence that is trained and classroom control in LOI learning varies according to the level. The higher the level of inquiry applied in learning, the intellectual intelligence trained will be higher [1], [6], [28]. The same is true for classroom control in learning. The higher the level of inquiry that is applied, the more

free students are in determining learning activities.

**Model Inquiry Lesson**

One potential toward learning syntax of the inquiry lesson presented in Table 2. The syntax in the inquiry level has the same syntax, but different levels in each level are determined based on the intellectual intelligence of students and the controller. The inquiry lesson model is determined based on the learning support characteristics of the student's condition, the material being taught, and the learning support system.

**Tabel 2**. Syntax of Inquiry Lesson

| Syntax | **Student activities** |
|---|---|
| Observation | Observing phenomena that give rise to interest and response |
| Manipulation | Identifying problems |
| Generalization | Formulate the problem and prove it by the investigation process |
| Verification | Express ideas for drafting and conducting investigations |
| Application | Building new knowledge based on the investigation |

The description of the inquiry lesson model syntax developed as follows:

**Syntax 1. Observation**

Inquiry model to investigating and explaining unusual phenomena [35], [36]. The confrontation in question is a confusing and unusual situation experienced by students. To correlate problems with interesting and unusual phenomena to foster students' interest and response to learning. This is new so it is necessary to explain the investigation procedures clearly. In this phase, problems that can later be investigated. presents situations that make students curious and explains research procedures to students to give students experience in constructing new knowledge [18], [37], [38]. The ability to bring many ideas or alternative answers to problems smoothly, students' thinking activities with fluency and flexibility aspects. Furthermore, the abilities issued by students certainly have ideas that vary from different points of view, thoughts when problems are presented, something that confuses students will be able to solve them in their ways, so aspects of fluency and flexibility are seen as very important skills to solve problems and come up with new ideas in the confrontation phase with unusual problems.

**Syntax 2. Manipulation**

It is a process where students gather information on an event that they see or experience by collecting data to solve problems and bring up new ideas [17], [32], [39]. Subsequently analyzed, the data was verified based on the purpose of the investigation. The activity in the second phase shows that analyzing activities require new ideas and different ideas adjust to the level of problems faced by students so that fluency is needed when the ideas and ideas are different, flexibility when students adjust problems with different approaches, elaboration when verifying data by selecting the right solution as well as redefinition the verification process again.

**Syntax 3. Generalization**

Introducing new elements into problem situations to find out if something else might happen when their research data is tested differently. Exploration, changing something to see what will happen should not be guided by theory and hypothesis. Direct testing appears when students test theories and hypotheses, the process of converting hypotheses into trials is not easy and requires a lot of practice. To research a theory, we need to ask lots of questions about verification and experimentation.

Furthermore, make assumptions on the investigation that has been done to test the hypothesis, accepted or rejected the investigation hypothesis, the ability to issue expressions, ideas, or ideas to solve problems or unique, new which is not thought of by others, generates new ideas by combining, changing or adding to existing ideas.

**Syntax 4. Verification**

The teacher asks students to process data and formulate an explanation is Creative thinking skills can be ask questions a knowledge environment [40]–[42]. The teacher asks students to process data and formulate explanations. The ability to think creatively can ask questions of the knowledge environment. Data acquisition formulated through creative ideas greatly determines the fluency in extracting data based on learning activities.

**Syntax 5. Application**

Finally, in the fifth stage to apply the results of their research [35], [43]. Creative thinking skills are original and reflective ways of thinking and produce complex products the effectiveness of existing ideas. The inquiry provides instructional and accompanying impacts in the form of the spirit learning [44].

The findings of each syntax inquiry lesson contribute to creative thinking skills, but it is important to study it in future research on its effectiveness in fostering creative thinking.

**The Relationship between the Inquiry Lesson Model Components and the Indicators of Creative Thinking**

The related assumptions are explained through relevant sources to provide an overview of research studies. The findings generated in the form of Model Inquiry Lesson can enhance and foster creative thinking skills directly without choosing certain indicators.

**Table 3**. Results of Systematic Review Inquiry

| Data Source | Finding |
|---|---|
| [5], [10], [50] | The Inquiry model can improve students' creative thinking skills |
| [13], [44] | The discovery in level inquiry of new definitions by students. |
| [12], [51], [52] | The relationship between creative thinking skills and scientific inquiry. |
| [11], [21], [40], [53] | The Inquiry model to develop creative students. |
| [44], [47] | The Inquiry model contributed students' intellectual |
| [54]–[57] | The Inquiry can be potential scientific understanding |

Table 3 shows the application of the Inquiry Lesson to Convergent thinking activities as a form of creative thinking. Next is presented an important review in each of the syntaxes of the Inquiry Lesson model is significantly more effective than conventional learning. Furthermore, it can be presented (table 4) research findings.

**Table 4**. Research results on Literature Review

| Creative Thinking Indicator | Sub Indicator | Source | Finding |
|---|---|---|---|
| Fluency | The sparking ideas and problem solving.<br>to provide methods or advice<br>The alternative answers thinking | [45], [46] | analyze and evaluate ideas to enhance and maximize creative efforts |
| Flexibility | Skills in generating ideas<br>The seeing problems from different of view<br>The finding many different alternatives<br>The ways of thinking | [17], [36], [37] | the ability to be flexible |
| | | | students can be open and responsive to different perspectives |
| Originality | The ability to give birth<br>The ability to combine | [2], [40], [47] | New views for students to provide answers to science problems |
| | | | generate new ideas by combining, changing or adding to existing ideas |
| Elaboration | The developing ideas<br>The detailing an object | [37], [48] | Formulating ideas to solve problems |
| Redefinition | Skills in reformulating creative products are not yet perfect | [4], [40], [49] | The Synthesize ideas and existing ideas skills |

Based on (table 4) that each indicator of creativity can be explored through certain models that are marked by student learning activities that require students to think creatively. Illustration of the Inquiry Lesson Model process in empowering indicators (Figure 4) causal process Inquiry Lesson and Indicators are based theories and approaches that are reviewed. The relevance Inquiry Lesson Model and creative thinking are strengthened through research [58] states that high level thinking one of which is creative thinking is formed the interaction between genetic factors (nature) in the form of intelligence and learning environment factors (nurture)

that often called epigenetics.

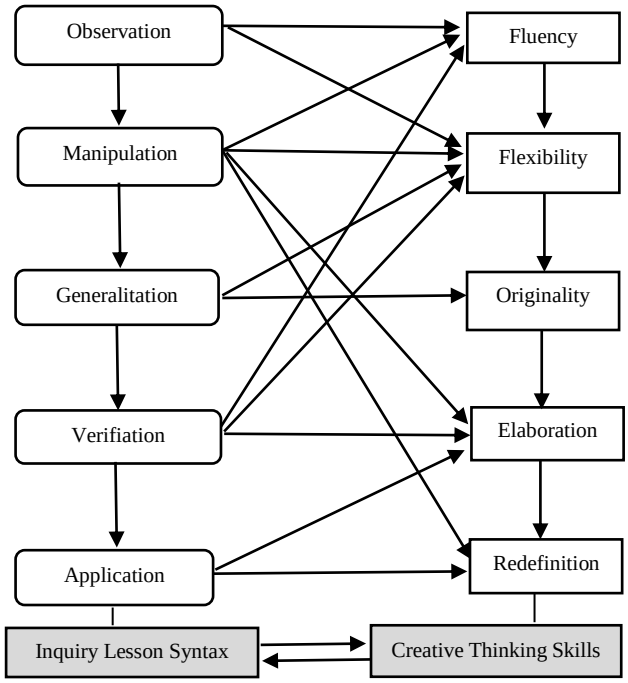



**Figure 4.** Causal Process Syntax Model Inquiry Lesson and Creative

The relationship between the Inquiry Lesson model component in (Figure 4) involvement to find applied it in everyday life, the process Inquiry students do not only act as the recipient of the lesson through the verbal explanation of the teacher, but the role of students to find their core of the subject matter through intellectual development. Creative thinking skills are the process of optimally utilizing intelligence through the enrichment of experience [59]. Intelligence and creative thinking skills are natural (genetic) that are permanent or dynamic that can change according to environmental stimuli (nurture) [60] so creative thinking skills will always change [18], [20].

The relationship between the syntax of the Inquiry Lesson model, the behavior of learning activities, and indicators of creative thinking skills to how important the contribution in empowering its. The Lesson Inquiry can train students' habits to think convergently through the stages of activity. Convergent thinking activity to creative indicator for thinking process [12], [61], [62]. The relationship between the Inquiry Lesson model component environment and science humanities [55], [63]–[67], in the Inquiry Lesson learning process students not only act as recipients of the lesson through the teacher explains verbally, but the student has a role to discover for himself the essence of the subject matter.

The contribution of this research lies in the potential of each inquiry lesson syntax in empowering creative thinking skills, that with the fluency of ideas that can formulate problems, questions to be proven through scientific performance are needed [68]. Inquiry-based science learning can teach students to practice creative thinking because creative ideas arise when stimuli make students change in their thinking processes [69]. the process of creative thinking starts with something unusual, gets out of the comfort zone, changes the ego and mindset in learning so that the potential to find something through creative products can be achieved [11], [14], [45], [70]. The thing that distinguishes it from other research is that the clarity of the contribution of indicators of creative thinking in literature can be justified. Most of the research on creative thinking only looks at how much creative improvement is given after being treated with a science learning model [5], [15], [40], without looking in detail at each indicator of creative thinking that gives the most dominant contribution.

## CONCLUSION

Inquiry Lesson as an effort to increase learning activities, creative thinking, and student independence. Science learning activities in scientific work based same level of inquiry in each syntax, this becomes an argument importance developing the inquiry lesson model. There needs to be a confrontation of problems that can explore students' ideas from unusual things before observing activities, fluency, flexibility, originality, elaboration and redefinition abilities can be fulfilled; collecting data as a process of verifying the data that has been collected so that it demands fluency, flexibility, Elaboration and Redefinition capabilities; Furthermore testing hypotheses to formulate questions through scientific activities, to accommodate the ability of flexibility in the ability to formulate hypotheses and Originality in activities generate new ideas that are different from each other.

Activities in organizing and formulating an explanation require the ability of fluency, flexibility, Elaboration as well as analyzing the inquiry process as feedback from scientific activities that are considered the most effective and thus require Elaboration and redefinition capabilities. These results indicate the importance of developing innovation learning models based on Wenning inquiry has not yet met all the indicators of creative thinking in each inquiry lesson syntax based on the Level of Inquiry study.

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