Promoting coupled-inquiry cycle through shared curricular integration models to enhance students argumentation

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Abstract. Systemic changes in key aspects of curriculum are essentially important because the challenges of emerged 21st century are growing rapidly. The changes made by the Indonesian Government in the 2013 curriculum, in line with such issue, are closely associated with scientific approach, student-centered learning, developing students thinking and collaboration skills, attitudes, exploring communication, and integrated learning. There are many schools teaching science partially. Not surprisingly, such obvious premises are leading to some overlapping subject materials among physics, biology, chemistry and inefficiency amount of time in classroom activities. Apparently, teachers have lots of difficult to design and integrate the science learning. To investigate the matter, the researchers are therefore interested to promote curricular integrated type employed by teachers in classroom, familiarly called as shared curricular integration. This type can be supported by coupled-inquiry cycle because it enables students to explore their argumentation. Moreover, the students’ argumentation activities can be supported through two fundamental investigations popularly called as experiment and communication through discussion. The methods of acquiring data were in regard to students’ argumentation tests and observation. The result of data analysis which is conducted with one sample t-test was coupled-inquiry cycle through shared curricular integration can enhance the students’ argumentation skills.

1. Introduction
The continuous development of curriculum in Indonesia educational setting is caused by rapid challenges within the 21st century period. The development of curricula is necessary to create future generations that can compete both nationally and internationally. The curriculum development is based on the following principles: 1) focus on potentials, development, needs and interests of learners and their environment, 2) diverse and integrated, 3) responsive to science development, technology and art, 4) relevant to the needs of life, 5) comprehensive and sustainable, 6) lifelong learning setting, and 7) balance between national and regional interests [1]. One of the developments that needs serious attention is an integration from all the subjects standing alone separately into subjects tied to one another by supporting core competencies. It can be said that the subjects are integrated. As science subjects that are no longer taught separately such as chemistry, physics, and biology. The contents standard in the 2013 curriculum [2] also mandates that science subject in Junior High School is developed as integrative
science subject, applicative-oriented, development of thinking ability, learning ability, curiosity, and caring attitude and responsibility towards the natural environment. Some experts argue that integrated science learning is a combination of several scientific disciplines that is among physics, biology, and chemistry.

In fact, the implementation of science learning in some schools is fragmented not integrated. This is consistent with the problem in the research that science learning was performed partially [3]. The integrated concept has not been reflected in the process of learning implementation in the classroom. The same problem was also revealed in the research observation at SMPN 3 Satu Atap Ayah that the integrated science learning in the school has not been implemented [4]. The result of interview at SMPN 1 Madiun revealed that the integrated science learning has not been implemented optimally [5]. Based on the result of questionnaires given to students, it revealed that integrated science learning at SMP 1 Madiun was still taught separately between physics and biology. Based on the interview of two Junior High School’s science teacher in Kota Bandung that sometimes they are difficult to organize the three subjects (physics, biology and chemistry) as one subject. In general, there are some obstacles experienced by teachers in applying integrated science learning, namely: 1) readiness of teachers, so far natural science teachers have separate or different scientific disciplines background, such as physics, biology and chemistry, 2) the lack of learning tools, media or learning resources such as textbooks containing integrated science concepts both in handbooks for teachers and students, and 3) difficulties in integrating science concepts into an integrated learning [4].

Integration in learning is an approach that connects or unites various fields of science study into a single unit. Integration in science learning should also includes the dimensions of attitudes, processes, products, applications, and creativity [2,6]. From a number of integrated science learning models proposed by [7,8], there are four potential models to be applied in integrated science learning, namely: connected, webbed, shared, and integrated. The four models are selected because the concepts in Basic Competency (KD) of science have different characteristics, so that it requires the appropriate model to provide optimal results. One of the curricular integration is shared type. Shared curricular integration is like looking binoculars. As the two lenses are adjusted, a more focused view result. Shared planning and teaching take place in two disciplines in which overlapping concepts or ideas emerge as organizing elements [8]. For example, biology and physics are paired as one. Then, teachers use data collection through experiment and discussion as shared concepts. While learning, this shared type is not only focus on concepts but also the attitudes and skills. This shared type is related to the content standard which also mentions about the objective of science learning specifically aims to develop students to have scientific attitudes. In the middle schools, the science teachers need to build a team for create the preliminary planning concepts with a notion of key concepts, skills and attitude. As the pair indentify priorities, the teachers look for overlaps in content. Based on the interview, students still need teacher guideness from observation until discussion. Sometimes, it takes much time and ineffective learning. It means that guided inquiry was applied because teacher helped students from the first until the end of learning. Also, teachers who believe that students are doing inquiry only in a completely open-ended lesson. This leads many teachers to conclude that inquiry is too difficult to do and thus do not attempt inquiry at all [9,10]. Actually, there is coupled inquiry, a type of inquiry not mentioned in the continuum of NRC, is a combination of guided-inquiry investigation with an open-inquiry investigation; students begin with questioning, investigate the issue, doing experiment and then students engage in open-ended inquiry based on discussions or personal interest [11,12]. In this learning, teacher only helps students only in the introduction of learning and until experiment session. For the rest, like discussion session, teacher will give a time for students to explore about their knowledge by using argument.

Based on the research that has been conducted also pointed out that many of the students’ skill in providing argumentation was still minimum. In accordance with the statement that has a lot of research that shows about the lack of students’ skill in arguing [13]. Their research shows that there is a difficulty experienced by students in constructing the nature of scientific argumentation. A similar study is also conducted by other researchers that many of students arguing ability are still very lack. The lack of students’ skill in arguing might be reviewed from how students perform the steps in the reason for
learning [14]. Related to the other’s research that students at secondary schools are still very weak in constructing arguments [15,16].

In this present study, researchers fundamentally attempt to promote the coupled inquiry through shared curricular integration and analyse the students’ argumentation skill.

2. Methods
This research is a quantitative research. The researchers employed a quasi experimental methodology which is one of the powerful research methodologies. The quasi experimental methodology is the best way to establish cause-and-effect relationships among variables [17]. In this study, the independent variable is the coupled inquiry as a learning model through discussion activities as method and the dependent variable is students’ argumentation. There are some quasi experimental research designs. The researchers apply one group pretest and posttest design. A diagram of this design is show in Figure 1, where $X$ symbolizes the treatment with coupled inquiry learning, $O_1$ as pretest and $O_2$ as posttest.

![Figure 1. The One Group Pretest and Posttest Design](image)

The sample of this research was drawn from one of junior high school grade 8A in Kota Bandung, Indonesia. A convenience sampling strategy was used because of the school’s rules. Those sample were also taken by the equality of students’ achievement and science teacher’s suggestion. A certain group of people was chosen for study because they were available. The obvious advantage of this type of sampling is convenience. For experimental and causal-comparative studies, some experts recommend a minimum of 30 individuals per group. In this study, the number of participants are 32 students. This sample size drawn by the ability of researchers with a reasonable expenditure of time and energy. When treatment is applied, students are grouping as 6 groups. Each group contains with 5-6 students.

In this study, researchers employed some instruments such as interview schedule, observation sheets and argumentation test. Researchers interviewed 2 science teacher to gain more information about science learning and the assessment component which is using during and after learning. This interview was conducted before the treatment is applied. During the class, researcher employed an observation sheet as the instrument. The observation sheet contain with teacher and students learning activities by using coupled inquiry.

After the class, students’ asked to answer the argumentation test. The test consists of five essay question. This test will be measured by the scoring rubric based on the argumentation components such as claim, data, warrant and backing. The instrumentation should be consider about its validity and reliability. Researchers applied content and empirical validity. The content validity measured by four expert judgment; three are lectures from physics, chemistry, and biology department and one from science teacher who teach science about 10 years. Empirical validity also applied by using product moment correlation or Pearson’s correlation. The observation sheets and interview schedule data obtained were analyzed through description. For argumentation test, the data were analyzed through t-test by using SPSS version 22. Normality test also applied in this study.

3. Result and Discussion

3.1 Shared Curricular Integration Design
The related concepts that have been taught in shared integration learning as the figure 2. Based on the figure 2. theme planning was the first step that the researchers and science teacher did. The theme was choosen based on some overlapped concepts. Then, the overlapped concepts organized as one concepts; the process of how human could hear the sound. In this stage, researchers and science teacher also developed the types of theme by wriiting the advantages and limitations [7,8,18]. Consequently, the one concepts could formulated. Based on this research, this design was really helpful for teacher to decrease the time consuming during learning in the class and more effective. For students, they would receive a
broadly knowledge about science. They not only learn physics, biology or chemistry but they learn science. In the shared curricular integration, there are skill and attitudes aspects that will assessed by the teacher. These are related to research [19,20,21,22,23] that there are some positive outcomes of shared integration such as the shared integration would help students apply skills, leads to faster retrieval of information, and encourage depth and breadth in learning. Curricular integration focuses with a certain subject or theme associated to other subjects, a particular concept is associated with another concept, which is applied spontaneously or planned, either in one or more fields of study, with a variety of students’ learning experiences, so that learning becomes meaningful [12,24].

![Diagram of Physics Sound and Biology Auditory System](image)

**Figure 2.** Shared integration design

### 3.2 Coupled Inquiry Learning Design

The inquiry continuum combines levels of student and teacher participation with inquiry strategies to demonstrate a progression from teacher-centered to student-centered inquiry, as the figure 3.

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Confirmation → Structured → Guided → Coupled → Open-Ended
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**Figure 3.** Definitions of scientific inquiry compiled into one inquiry continuum

In the figure 3 shows that coupled inquiry is in the middle level of guided and open ended inquiry learning. Based on literature study [11, 12, 25, 26, 27, 28, 29, 30, 31] the researchers drawn the coupled inquiry learning as the Table 1.

| Table 1. Coupled Inquiry Design Developed by The Researchers |
|-------------------------------------------------------------|
| **Steps** | **Activities** | **Teacher** | **Students** |
| Invitation to inquiry | Display phenomena related to topic about how human could hear when others are talking | Observe the phenomena |
| Initiated guided inquiry | Pointing out students to questioning | Questionning about the phenomena |
| Exploring knowledge | Helping students if there are any obstacles | Investigate the phenomena by doing experiment |
| | | Collect data from experiment in the form of tables |
| Initiated open inquiry | Observing students during discussion session | - Share results and then students engage in open-ended inquiry by discussion about the data related to experimental results to find the answer for the proposed phenomena (communication skill) |
| | | - Students draw conclusion and present the result of observation (appreciate to each other’s opinion during presentation) |
By beginning with an invitation to inquiry along with the guided inquiry, the teacher chooses the first question to investigate [24, 22]. The coupled-inquiry cycle is as follows: 1) an invitation to inquiry, 2) teacher-initiated “guided inquiry,” 3) student-initiated “open inquiry,” 4) inquiry resolution, and 5) assessment. This cycle can then lead back to more student-initiated open inquiry [11, 24].

Firstly, student would like to observe and questioning about the phenomenon. At this stage, students will be confronted by existing real-world phenomena that makes students to be responsible for solving problems [5, 24, 25]. Using the coupled inquiry learning not only concepts will be mastered by the students but also skill and attitude through experiment and discussion methods also during the learning. Experiment and discussion are the parts of coupled inquiry learning. After the guided inquiry, a more student-centered approach is taken by implementing an open-inquiry investigation. This approach of guided inquiry followed by open inquiry results in student-generated questions that closely relate to the standard or benchmark from the first investigation. Specific concepts can be explored in a more didactic fashion allowing students to connect their concrete experiences to abstract concepts, similar to a learning-cycle approach [26].

The experiment method is a method of presenting a lesson in which students conduct experiment directly and prove themselves something learned [32]. Through experiment, students experience directly and can freely express their desire to solve the problem of a phenomenon. While conducting an experiment, there is a process of constructing knowledge by using students’ creativity [27, 30, 31]. According to Piaget’s theory of cognitive development, students at junior high school level learners are in the period of transition from concrete operational stage toward formal operational stage. At this stage, students begin to build a correlations proportionately [28].

3.3 Students’ Argumentation Skill

Students were given a pretest in the first meeting of class; an argumentation test. This test helped a researcher to gain more information about the prior argumentation skills of their students. After treatment, coupled inquiry learning through shared curricular integration, students must have a posttest. This posttest would help teacher to gain any information about the differences of students’ argumentation skill before and after treatment. Before the one sample t-test applied, the normality test is needed. The data analysis of normality test was using Saphiro-Wilk test through SPSS software. Table 2 shows a test result of students’ argumentation.

| Table 2. The Test Results of Students’ Argumentation in Coupled Inquiry Learning |
|---------------------------------|-------|--------|---------------|----------------|
|                                | Mean  | N     | Std. Deviation | Std. Error Mean |
| Pretest                        | 31.04 | 32    | 11.206         | 1.981           |
| Posttest                       | 70.94 | 32    | 11.248         | 1.988           |

The data in the table 2 shows that the mean score before the treatment is 31.04 and after the treatment is 70.94. There is an increasing values. To conclude that the mean score of students’ argumentation after the treatment, a coupled inquiry learning through shared curricular integration, is mostly increase. Before conducting hypothesis test, it is necessary to carry out on students’ argumentation ability from the posttest. Normality test using Kolmogorov Smirnov and Shapiro-Wilk method precede equivalence test. The result of normality test can be seen in Table 3.

| Table 3. Summary of Normality Data Test |
|----------------------------------------|--------|----------|--------------|-------------|
|                                        | df     | Sig      | Decision     | Conclusion  |
| Pretest                                | 32     | 0.178    | H₀ is accepted | Normal     |
| Posttest                               | 32     | 0.883    | H₀ is accepted | Normal     |

From the table 3 the signification is upper from alpha values, $\text{sig} = 0.178 > \alpha = 0.05$ for pretest and $\text{sig} = 0.883 > \alpha = 0.05$ for posttest. This means that $H₀$ is accepted and the data is normal. Hence, prerequisite tests including normality test is fulfilled. The obtained data is analyzed using one sample t-test can be seen in table 4.
Table 4. One Sample T-test Result

|                  | Std. Deviation | Std. Error Mean | t     | df | Sig (2-tailed) |
|------------------|----------------|-----------------|-------|----|----------------|
| Pretest – Postest| 12.048         | 2.130           | -18.733 | 31 | .000           |

Based on the result seen in the table 4, it is obtain that the signification values is smaller than the alpha values, sig = 0.00 < α = 0.025. Thus, it can be concluded that there is a significant differences before and after the coupled inquiry learning through shared curricular integration applied. It means that the coupled inquiry learning through shared curricular integration could enhance students’ argumentation.

The result of hypothesis test demonstrated that learning models disclosed different influences. Such findings were also related to the last activity of coupled inquiry learning. The last activity was communicating through discussion or presentation in front of the class. In this line, students are asked to explain what they have investigated through such formulated activities. Discussion is one part of communicating the results of experimental activity [34]. It is considered valuable to help students to improve their skills to make the relationship between statement and fact; it shows how to improve argumentation skills [12,15,35,36]. Discussion method is a method conducted through question and answer with the aim of exploring the students’ ability to reason and think [16]. The reasoning skills related to argumentation stages are 1) claim; is an idea, inference, hypothesis, or opinions towards an event or phenomenon, 2) evidence; used to support the claim, 3) warrant; the reason given for links the evidence with the claim, 4) backing; basic assumptions to support warrant [37]. The component argument Toulmin (1958) is the basic structure of the argumentation that is capable of enhancing the student's argument orally and in writing [38]. Based on the research results that much of the learning process that occurs in the arguments either in individual or group activities involving thinking deeper and integrate new knowledge with students' prior knowledge [16]. So learning that involves arguing that was built by individuals and groups can support an understanding of students in scientific concepts. Having group discussion while learning could help students build an argument and reducing misconceptions.

4. Conclusion
Based on results obtained in this line of research, the researchers would simply like to draw the attention once more to the fact that coupled-inquiry learning through shared curricular integrated learning can enhance the students’ argumentation skills. Besides, the shared curricular integration could reduce the overlapping concept and time consuming during classroom activities. The used methods, after all, through experiment and interactive discussion can support the argumentation activities because the discussion session involve a number of valuable and useful thoughts and reasoning. Discussion models are notably able to help students to state a claim, collecting and formulating data, making a relation between data and demonstrate it as warranty. There is also emerging evidence that the coupled-inquiry learning through shared curricular integration could help teachers during delivering scientific lessons in educational settings.

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