Argument Based Science Inquiry (ABSI) Learning Model in Voltaic Cell Concept

C Z Subarkah*, A Fadilah and R Aisyah
Program Studi Pendidikan Kimia Fakultas Tarbiyah dan Keguruan UIN Sunan Gunung Djati Bandung, Jl. AH. Nasution No. 105, Bandung, Indonesia

*zenabc@uinsgd.ac.id

Abstract. Voltaic Cell is a sub-concept of electrochemistry that is considered difficult to be comprehended by learners. Voltaic Cell is a sub concept of electrochemistry that is considered difficult to be understood by learners so that impacts on student activity in learning process. Therefore the learning model Argument Based Science Inquiry (ABSI) will be applied to the concept of Voltaic cell. This research aims to describe students’ activities during learning process using ABSI model and to analyze students’ competency to solve ABSI-based worksheets (LK) of Voltaic Cell concept. The method used in this research was the “mix-method-quantitative-embedded” method with subjects of the study: 39 second-semester students of Chemistry Education study program. The student activity is quite good during ABSI learning. The students' ability to complete worksheet (LK) for every average phase is good. In the phase of exploration of post instruction understanding, it is categorized very good, and in the phase of negotiation shape III: comparing science ideas to textbooks or other printed resources merely reach enough category. Thus, the ABSI learning has improved the student levels of activity and students’ competency to solve the ABSI-based worksheet (LK).

1. Introduction
Chemistry is part of science. Chemistry often consider difficult to understand by the student because so many special words and abstract concept [1]. One of the concepts that consider difficult to understand and complicated is electrochemistry. In electrochemistry there is one of the sub-concept is voltaic cell [2]. Some of the sub-concept in voltaic cell is abstract with concrete example. Learning process in voltaic cell involves practicum activities. Each university graduate student can go through a scientific approach as a character of the standard learning process [3]. The learning process through a scientific approach consists of five basic learning experiences: observing, questioning, gathering information, associating, and communicating [4]. These five basic learning can be carried out by students through practicum and arguing activities. During practicum of voltaic cell, the changes during redox reaction can be observed directly but the explanation of the reasons or arguments about the changes is difficult to understand because it is abstract. Therefore, an alternative learning model that includes practicum and argumentation activities is needed.

One of the learning models that can be applied to the concept of Voltaic cell is Argument Based Science Inquiry (ABSI). Various research on the application of ABSI has been carried out, one of them is that scientific writing skills and arguing activities of the learners more increase in addition to increasing their learning outcomes, when the Argument Based Science Inquiry (ABSI) model of learning is integrated with multi-modal representation [5]. Other studies have reported that learners...
who are learning with ABSI have improved in understanding the concepts, attitudes, and ability to argue [6]; [7]; And [8].

The update on this research is Voltaic cell learning process by using worksheet (LK) based on ABSI. Therefore the aim of this research is to obtain information about: (1) student’s activity on learning ABSI and (2) the ability of student to complete worksheet based on ABSI on Voltaic cell.

2. Experimental Method
The experimental method used is quantitative embedded mix method [9]. The subject of this research is 39 students of the second semester of Chemical Education Study Program in one of State University in Bandung City. The second semester students come from various higher schools, so not all students are accustomed to have practicum and argumentation activities. The method of research was problem identification, preparation, implementation, and reporting. The student’s activity data obtained through observation activity during learning process by the observer. While the data of student’s ability in completing worksheet based on ABSI was obtained through worksheet completion analysis by giving score on every learning phase in worksheet and then averaged its value. The worksheet (LK) used is made in accordance with the phases of the ABSI learning model.

3. Result and Discussion
Voltaic cell can produce electricity because of the spontaneous redox reaction. Figure 1 shows how the Voltaic cell works which converts the redox reactions to the electricity, in the presence of electron displacement [10]. The changes caused by redox reactions can be observed directly. But the explanation of why and how the redox reactions can occur is still difficult to understand. The students' understanding of the function and role of each component in the voltaic cell needs to be thoroughly considered. The concept of Voltaic cell will be preferable understood by students if they are directly involved in practicum activities. Their understanding will be much better if after the practicum done the discussion so that the argument activities take place. Application of the ABSI learning model can facilitate the student activities during practicum and practice to argue with. The things that are considered difficult to understand the process of redox reactions on Voltaic cell can be conveyed.

![Figure 1. Voltaic Cell](image.jpg)
Figure 2. Percentage of student group activity for each phase of ABSI learning

Figure 2 shows that the result of the student activity observation from phase 1 to phase 7 is categorized very well. The learning phase in ABSI learning process are: (1) Exploration of pre-instruction understanding, (2) Participation in laboratory activity, (3) negotiation shape I: writing personal meaning for laboratory activity, (4) negotiation shape II: sharing and comparing data interpretations in small groups, (5) negotiation shape III: comparing science ideas to textbooks or other printed resources, (6) negotiation shape IV: individual reflections and writing, and (7) exploration of post instruction understanding [11]. The average percentage of student activity for the whole ABSI learning phase is 96.43% with very good activity category. Phase 1 obtained the lowest percentage of activity at 83.33% because students are not actively answering questions about applications of the Voltaic cell in everyday life, due to the question has not been optimal in motivating the students. Motivation is a way of using enthusiasm in an activity to achieve the greatest satisfaction in our needs [12].

Figure 3. Score obtained in worksheet based on ABSI for every group student for each phase of ABSI learning

The ability of students to complete the ABSI based worksheet can be seen in Figure 3. The figure shows that the highest average score in worksheet is found for phase 7 for exploration of post instruction understanding while the lowest average score is found for phase 5: negotiation shape III: comparing science ideas to textbooks or other printed resources. The average score worksheet based on ABSI is 76.51. As for the learning indicators in phase 1, students can answer questions about redox reaction equation as a prerequisite concept of Voltaic cell, answer the question of application of Voltaic cell in daily life such as dry batteries, and listen to a brief explanation of electrochemistry presented by the researcher. This is done to find out the student’s basic understanding of redox
reactions. When students can answer the questions about redox reactions and about the concept relationship of redox reactions with the Voltaic cell means that students have undertaken meaningful learning activities. The assimilation theory explains that meaningful learning is how a new knowledge can be combined with existing knowledge in a person’s cognitive structure [13]. The result of ABSI based worksheet in phase 1 is 83.33 (Figure 3). It shows that students finds no significant difficulties but is less motivated with question about the battery as an application of Voltaic cell.

Learning indicators in phase 2 are students can make problem formulation, hypothesis, experiment variables, experimental design, experiment, and writing the results of Voltaic cell observations. In this phase there are 2 groups that still have difficulties to make the problem formulation due to the student’s confusion with the hypothesis that will be made to answer the problem formulation. Uncertainty leads to doubts and fears of doing a mistake which hamper the learning process [14]. The result of ABSI based worksheet in phase 2 is 71.67 (Figure 3). It shows that in phase 2 the students complete the task well although there are still groups that are difficult in formulating the problem and making the hypothesis. Learning indicator in phase 3 is students can interpret the data of experimental results by answering the questions on the ABSI based worksheet. In phase 3, the students did not find any significant difficulties because during answering each question the students conducted discussion, cooperation, and sharing tasks so that each question could be answered by the students. If the discussion goes well, then the discussion can encourage students to think critically and can improve the ability of the average students or underachievers to participate in the learning process [15]. During completing tasks in this phase required cognitive processes. Cognitive domains include the mental activities (brain) related with the thinking ability, including memorization, understanding, applying, analyzing, synthesizing, and evaluating skill [16]. The result of ABSI based worksheet in phase 3 is 76.85 (Figure 3). It shows that in this phase students have been able to answer the questions related to the experiment well although there are two groups that get the score with enough categories.

In phase 4, the developed learning indicator is students are able to make tentative arguments based on experimental results. The tentative components of the argument that must be presented are claims, data, justification (warrant), and support or of the claim (backing). This is in agreement with fairly complex argumentation patterns which are claim, data, warrant, backing, and rebuttal [17]. Based on the results of observation, as in the previous phase, in completing the task of making this tentative argument students are actively discussing, dividing the tasks, and searching the relationship between the data obtained with claims made through the source book learning and internet. Students seem very active in expressing opinions. At this phase, the important activity of students is writing their opinions or ideas to make tentative arguments. Writing skill is an active-productive skill because it is not only transfers words and sentences but also pours and develops thoughts, opinions, ideas in an orderly logical systematic writing structure so it can easily to be understood by the readers [18]. The result of ABSI based worksheet in this phase is 78.13, indicating that students have been able to make argument tentatively well because students in this phase actively asking about component of tentative argument to the researcher.

The developed learning indicators in phase 5 are students able to carry out arguments or argumentation activities based on tentative arguments that have been made. In phase 5, score of student’s completion can be categorized sufficient. In this phase, the average score is not optimum yet due to the most students seem not ready with the strategy that will be used when arguing. This resulted in less effective use of time and less activeness of the students during arguing. In this phase, student’s ability to think logically is required.

In phase 6, the developed learning indicators are students can make reports of experimental results. Some groups are still less relevant in drawing conclusions from experiments that have been made and citing on an unfinished basic theory. This is caused by students who are not actively inquiring and reading rules of writing true scientific papers. Writing skills should be supported by reading and listening activities as the various information related with the experimental result which can be obtained through reading and listening [19]. The result of ABSI based worksheet in this phase
is 84.90 (Figure 3). It shows that the students have been able to write report of experimental results very well because they actively ask about systematic report to the researcher.

The developed learning indicator in phase 7 is repeating the explanation of Voltaic cell that has been learned. When the researcher asked the question, most of the students raised their hands to answer. This is an indicator that students have been able to accept the concept of Voltaic cell that has been studied. However, there are two groups that appear to be inactive at this phase because focus of the students is decreasing as the researcher explains the concept. Each learner including a student will respond differently to a particular solution depending on the process of approach they use [20]. The concentration of learning process for 30 minutes has decreased [21]. The result of ABSI based worksheet in this phase is 87.50 (Figure 3) shows that the average high score is obtained because students have learned the concept of Voltaic cell well so that they can repeat the explanation of Voltaic cell concept.

4. Conclusion
ABSI learning model affects the activity and the ability of students in completing worksheet based on ABSI. The students’ ability in the argument show that they need to be trained continuously in order to get used to dare to express their opinions. Further research on other concepts on chemistry that have a characteristic such as Voltaic cell concept to explore concept that can be done to enrich ABSI based learning model in improving the activity and learning outcomes is needed.

Acknowledgments
The authors acknowledge the help and contribution of The Dean of Tarbiyah & Teaching Training Faculty. Also, we express our thanks to The Head of MIPA Education Department and The Head of Chemical Education Study Program of UIN Sunan Gunung Djati.

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