Developing students’ scientific argumentation skill in hydrolysis salt learning

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Abstract. This study was aimed at investigating students’ scientific argumentation skills (SAS) in hydrolysis salt learning. It applied classroom research with the design of a one-shot case study. It collected data by measuring students’ SAS after they studied hydrolysis salt. SAS in this study was assessed through the scale of argumentation quality referring to the framework of TAP (Toulmin Argument Pattern). This study found that students’ SAS were at level 4, that is they could argue with clear objections in hydrolysis salt learning because they could relate indicators of claims, evidence, reasoning and rebuttal. They achieved this after they had gone through inquiry process and practicum program to develop their SAS. They performed SAS well in learning hydrolysis salts.

1. Introduction
A good learning process requires students to develop their ability to think critically, solve problems, collaborate, and communicate [1]. In the context of science learning, it should provide students with ample opportunity to engage in learning by conducting scientific thinking skills [2]. In line with this, Kurniasih and Setyarsih argue that students’ ability to communicate plays an important role in science learning. One of communication skill in learning is scientific argumentation skill (SAS) [3]. SAS is different from everyday argumentation in general since it contains three aspects namely claims, evidence and reasoning[4].

SAS refers to activities aimed at developing logical scientific knowledge that connect both ideas and evidence in science learning context [5]. It is crucially needed in chemistry subject learning. Chemistry offers various topic and one of them is the hydrolysis salt learning. To learn this topic, students are required not only to know salt solution but also to explain why salt solution can be acidic, base and neutral and its calculations [6]. In Chemistry learning with the topic of hydrolysis salt, there is a need on the part of students to perform SAS. Previous research related to students’ SAS development through argumentative inquiry learning in colloidal chemistry concepts had been conducted by Farida and Gusniarti. Their results showed that the students’ quality of oral argumentation was better than their written argumentation [2].

There is a need on the part of the school to nurture students’ SAS. This skill is helpful to equip students in science learning process. Based on the description above, this study investigated SAS development in hydrolysis salt learning.
2. Experimental Method

The study used classroom study with a one-shot case study design. A one-shot case study is characterised with no control class, with no comparison class and no pretests [7]. It used the Argument Driven Inquiry (ADI) model which consisted of 8 stages: identifying tasks and questions, collecting and analyzing data, making argumentative statements, discussing statements, writing reports, double blind peer review, revising reports based on peer-review results, and performing explicit discussion and reflective. The subjects of this study were students of grade XI for Science Class, in one of state senior high school in Bandung City. Their number was 37 students in the even semester of 2017/2018 academic year. They were grouped based on their learning achievement which fell to high, medium and low criteria. Data was obtained after they learned the hydrolysis salt learning through SAS. Test was used in the form of essay questions consisting SAS indicators as measured by the quality level of SAS on the framework of Toulmin Argument Pattern (TAP) framework [8].

3. Result and Discussion

This study was aimed at investigating students’ SAS in hydrolysis salt learning. To measure SAS criteria, this study used the quality level of the argumentation level referring to the TAP framework. This level quality of argumentation which was based on the SAS used several indicators. These indicators were part of the TAP and they were grouped based on their achievement criteria. They can be seen in Table 1.

| No | Achievement Group | Test Score Based on SAS | Modus toward Level | Interpreting the Level |
|----|-------------------|-------------------------|--------------------|------------------------|
| 1. | High              | 5 5 5 4 3              | 5                  | Argument with Wide and Clear Objection |
| 2. | Medium            | 4 4 5 4 3              | 4                  | Argument with Clear Objection |
| 3. | Low               | 4 3 5 2 3              | 3                  | Argument with low reasoning/ objection |
|    | Modus toward the Level | 4 4 5 4 3             | 4                  | Argument with Clear Objection |

Explanation:
Indicator of SAS number 1, providing Claim, Evidence, Reasoning and Rebuttal concerning the salt that experienced hydrolysis).
Indicator of SAS number 2, providing Claim, Evidence, Reasoning and Rebuttal concerning the hydrolysis salt and PH calculation).
Indicator of SAS number 3, providing Claim, Evidence, Reasoning and Rebuttal concerning the property of salt based on its Ka and Kb.
Indicator of SAS number 4, providing Claim, Evidence, Reasoning, and Rebuttal concerning non-hydrolysis salt and its properties).
Indicator of SAS number 5, providing Claim, Evidence, Reasoning, and Rebuttal concerning the application of the hydrolysis salt concept).

Table 1. shows that the level of SAS for groups of achievement got level 4 means that there was clear objections to the argument they made in reasoning. In line with this, Ginanjur research showed that the argument at level 4 indicated that students were able to provide objections accompanied by supporting and relevant data or concepts [9]. The highest level was the high-ranking group with level
5 and the lowest level was the lowest group level with level 3. Other group belonged to the standard group performing level 4.

Out of five test questions, the highest level for the whole group of number 3 with level 5. They can be considered to have the ability to answer broadly with supporting arguments and the names of the subjects when they were learning. The learning indicators developed in this problem can determine the characteristics which was based on data from the Ka and Kb and writing down the arguments based on the statements presented. Almost all of the students answered in a straightforward frame because they could provide claims, evidence and objections correctly. They had the ability to explain and justify based on statements supported by data. This is part of their ability to perform scientific arguments [10].

While the lowest level for the whole group of candidates can be based on number 5 with level 3 criteria. This can be considered that students answered with weak objections. Their learning indicators in this study refers to their ability to determine the cations and anions of baking soda which can react with water and provide clarification and calculate the amount salt ion H\(^+\) atau OH\(^-\) which indicates that the salt is acidic or alkaline [11]. Most of their answers were less than expected. Some of them could work directly and correctly.

In general, the recapitulation of the quality level of SAS based on the standard group can be seen in Table 2.

| No | Achievement group | Level of Argumentation |
|----|-------------------|------------------------|
|    |                   | 0 1 2 3 4 5            |
| 1. | High              | - - - 1 3 4            |
| 2. | Medium            | - - 7 6 8 3            |
| 3. | Low               | - 2 2 - 1              |
| Total |                 | - - 9 9 11 8          |

Tabel 2. Shows the recapitulation of the student SAS quality which was obtained from SAS test at levels two, three, four and five. The quality of SAS level four was obtained by 11 students and the level five was achieved by eight people, level two was achieved by nine people and level three was obtained by nine students. Quality of argumentation can be seen in figure 1

![Figure 1. Graph of Student number recapitulation on each argumentation indicator](image)
In accomplishing test items which were compiled based on this SAS indicator, students needed to perform high SAS. It allowed students to develop their critical thinking skill [3]. Their ability to express ideas about the scientific phenomenon based on data/supporting evidence and existing theory reflects their SAS [9].

In general, SAS which was obtained after they studied hydrolysis salt can be said to have reached the highest level of achievement that is level 4. It means that they had been able to link the evidence, reasoning and rebuttal with arguments that have clear objections to the hydrolysis salt learning. It can be said that their SAS were more developed after they participated in both inquiry activities in the practice and argumentation activities. Inquiry activity and SAS in science learning developed their SAS with the following indicators: using scientific explanations, generating scientific argument, and participating in scientific practices [12].

4. Conclusion
Based on the results of this study, it can be concluded as follows: students’ SAS in learning hydrolysis salt were at the level 4. This indicated that they had arguments with clear objections and could link claims, evidence, reasoning and rebuttal in performing SAS.

References
[1] A. C. Pritasari, S. Dwiaestuti, and R. M. Probosari, “Peningkatan Kemampuan Argumentasi melalui Penerapan Model Problem Based Learning pada Siswa Kelas X MIA 1 SMA Batik 2 Surakarta Tahun Pelajaran 2014/2015,” *Pendidik. Biol.*, vol. 8, no. 1, pp. 1–7, 2016.
[2] Farida and W. F. Gusniarti, “Profil Keterampilan Argumentasi Siswa Pada Konsep Koloid Yang Dikembangkan Melalui Pembelajaran Inkuiri Argumentatif,” *EduSains*, vol. 6, no. 1, pp. 31–40, 2014.
[3] I. S. Kurniasari and W. Setyarsih, “Penerapan Model Pembelajaran Argument Driven Inquiry (ADI ) untuk Melatihkan Kemampuan Argumentasi Ilmiah Siswa pada Materi Usaha dan Energi,” *J. Inov. Pendidik. Fis.*, vol. 6, no. 3, pp. 171–174, 2017.
[4] P. H. Garam, “Hidrolisis Garam Hidrolisis Garam,” pp. 1–13, 2011.
[5] J. Grooms, P. Enderle, and V. Sampson, “Coordinating Scientific Argumentation and the Next Generation Science Standards through Argument Driven Inquiry,” *Sci. Educ.*, vol. 24, no. 1, pp. 45–50, 2015.
[6] N. Maikristina, I. W. Dasna, and O. Sulistina, “Pengaruh Penggunaan Model Pembelajaran Inkuiri Terbimbing terhadap Hasil Belajar dan Keterampilan Proses Sains Siswa Kelas XI IPA SMAN 3 Malang pada Materi Hidrolisis Garam,” *J. Kim. FMIPA UNM*, vol. 1, pp. 1–8, 2013.
[7] I. Farida, *Evaluasi Pembelajaran Berdasarkan Kurikulum Nasional*. Bandung: PT Remaja Rosdakarya, 2017.
[8] J. Osborne, S. Erduran, and S. Simon, “Enhancing the quality of argumentation in school science,” *J. Res. Sci. Teach.*, vol. 41, no. 10, pp. 994–1020, Dec. 2004.
[9] W. S. Ginanjar, S. Utari, and Muslim, “Penerapan Model Argument-Driven Inquiry Dalam Pembelajaran IPA Untuk Meningkatkan Kemampuan Argumentasi Ilmiah Siswa SMP,” *J. Pengajaran MIPA*, vol. 20, no. 1, pp. 32–37, 2015.
[10] A. S. Saracaloglu, H. Aktamis, and Y. Delioglu, “The Impact of the Developmet of Prospective Teacher’s Critical Thinking Skills on Scientific Argumentation Training and on their Ability to Construct an Argument,” *J. Balt. Sci. Educ.*, vol. 10, no. 4, pp. 243–260, 2011.
[11] R. Chang, *Kimia Dasar: Konsep-konsep Inti Jilid 2 Edisi Ketiga*. Jakarta: Erlangga, 2005.
[12] V. Sampson, J. Grooms, and J. P. Walker, “Argument-Driven Inquiry as a way to help students learn how to participate in scientific argumentation and craft written arguments: An exploratory study,” *Sci. Educ.*, vol. 95, no. 2, pp. 217–257, Mar. 2010.