Connections between prior knowledge and collaborative skill on discussion group about solar system related to descriptive scientific reasoning

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Abstract. The aim of this study is to analysis the connections between student' prior knowledge and collaborative skills in discussion groups associated with student scientific reasoning about the solar system. The student' prior knowledge contributes to building student scientific reasoning and supported by collaborative skills through discussion groups. The analysis between two variables that influence student scientific reasoning, namely prior knowledge and student collaborative skills. Method of this study is quasy experimental design with quatile approach. The group of student who took part in the astronomy lecture consisted of 5 groups each of which 6 student. The results of the prior analysis of student' knowledge of each group is quite low. Process, project and outcome predictions regarding prior knowledge and collaborative skills related to the formation of scientific reasoning have a high enough category in the aspect of results and a fairly low category in the process aspect. After the implementation of collaborative learning through discussion shows the results of research that significant relation between student' prior knowledge and student collaborative skills that streng then student scientific reasoning. Student tend to build scientific reasoning based on prior knowledge and discussion in collaborative learning. This is prior knowledge significantly influences the chronology of student in the discussion. Other found student with low prior knowledge experienced an increase in scientific reasoning through interaction and discussion in collaborative learning.

1. Introduction
Prior knowledge as the level of knowledge student have the start of learning, this knowledge is built and called back before the learning process. Prior knowledge is often considered the same by teachers when in reality this is not necessary the case. The results showed that prior knowledge had the greatest impact on learning. Those who have good prior knowledge can learn a certain topic better [1]. The researcher predicts that prior knowledge influences learning outcomes so the researcher chooses prior knowledge as a moderator variable. Prior knowledge of each individual as a combination of knowledge and skills. The influence of prior knowledge in the learning process, namely: (1) the prior knowledge includes a
new information category to be added to the existing knowledge structure, (2) the prior knowledge as an assimilation context for new material will complement each other to facilitate the construction of knowledge in the elaboration process and (3) early knowledge can increase access to knowledge during the learning process.

In addition, prior knowledge is the overall knowledge of each individual for various reasons, namely as knowledge that had existed before learning, structured in the schemata, including declarative and procedural knowledge, some explicit, containing content knowledge and metacognitive knowledge and dynamic nature. In addition, prior knowledge is a collection of individual knowledge and experience gained throughout the learning experience and integrated into new experiences. Prior knowledge is useful for organizing effective collaborative learning. In collaborative learning there is a reciprocal relationship, student can learn from each other to improve understanding of concepts and enhance social interaction that can develop student knowledge.

Collaborative learning is more fun and interactive with virtual laboratory facilities combined with classroom learning to explore student reasoning [2]. Collaborative skills can succeed with the help of virtual spaces such as online tutorials, forums, and collaborative and communicative tools strongly support project-based learning and assignments [3]. In connection with collaborative learning to build collaborative skills one can use multimedia shows depending on the level of student’ prior knowledge [4]. Scientific reasoning in collaborative learning can be held with the help of games to motivate and involve student in learning physics and improve student' astronomy knowledge [5]. Scientific reasoning affects the ability of problem solving in learning physics to grow the ability to explain predictions and thinking processes [6]. Student interest in learning depends on prior knowledge and subject matter [7]. The results of the teacher's analysis of the relationship between prior knowledge and learning are stated when the teacher applies prior knowledge to the context has implications for the development of concept understanding [1]. Direct activities in the laboratory can enhance the ability to develop professional skills [8]. Individual knowledge is strongly influenced by student' prior knowledge practically in learning [9]. Understanding the characteristics of student more effectively helps teachers organize the learning process [10]. The teacher identification results state that student competency is better enhanced through collaborative learning [11].

Prior knowledge as a basis for developing other knowledge and subsequent knowledge [12]. Other treatments can lead to student' collaborative skills through the intelligent collaborative learning system [13]. Early knowledge influences learning important points for mutual consideration based on individual differences [14]. This learning can be realized in the form of group discussions that have various advantages, namely involving all student directly in the learning process. Each student can test their level of knowledge and learning material. The method of discussion can foster and develop scientific thinking and attitude. But some weaknesses of group discussion are group participation of each individual and the time required is longer, the dominance of the discussion by a few student, the selection of discussion topics that are challenging and interesting. Collaborative learning can increase creativity and productivity because there will be more exchanges of ideas and unique experiences and increased access to diverse social networks for information collection and dissemination [15]. It can use communication tools in online learning to develop collaborative skills [14]. Collaborative learning is directed at developing HOTS skills [16]. This study describes the relationship between student's prior knowledge and collaborative skills in discussion groups related to scientific reasoning on the topic of the solar system. The aim of this work is to obtain correlation between prior knowledge and collaborative skills in discussion for explore scientific reasoning.

2. Research Method
This research involved 5 groups of 30 student in Physics Education Department who took part in astronomy lectures on academic year 2019-2020. The research variables are prior knowledge and collaborative skill. The instruments in this study consisted of test and non-test instruments. The test instrument is an prior knowledge test related to scientific reasoning in the form of student' abilities
before learning takes place and non-tests in the form of observation sheets of student collaboration skills and questionnaire for student response. Data collection through tests is given to student and observations are made by the teacher to analysis student collaboration skills. The student's prior knowledge test consists of 5 descriptive questions. Prior knowledge test results are divided into three categories: high, medium and low. Data analysis techniques used descriptive statistics analysis to illustrate the relationship between prior knowledge and student collaborative skills related to scientific reasoning. Inferential analysis is used to analysis the relation between prior knowledge and student collaborative skills related to scientific reasoning. The research process as shown in Figure 1.

![Figure 1. The research process](image)

### 3. Result and Discussion

Descriptions of prior knowledge and collaboration skills of student that show the quality of scientific reasoning in solar system lectures as shown in Table 1.

| Description                  | Minimum | Maximum | Mean  | SD   | Correlation |
|------------------------------|---------|---------|-------|------|-------------|
| Prior Knowledge              | 10      | 50      | 18.83 | 4.29 | -0.015      |
| Collaborative Skill          | 25      | 75      | 63.67 | 6.06 |             |

The correlation of prior knowledge and student collaboration skills is quite low at 0.015. Description of prediction processes, projects and results of prior knowledge and scientific reasoning abilities as shown in Table 2.

| Description     | Process | Project | Result |
|-----------------|---------|---------|--------|
| Accuracy        | 32      | 36      | 45     |
| Remediation     | 38      | 35      | 43     |

Table 1. Description of the correlation of prior knowledge and collaboration skills of student

Table 2. Predicted processes, projects and results regarding prior knowledge, collaborative skills related to the formation of scientific reasoning
Process, project and outcome predictions regarding prior knowledge and collaborative skills related to the formation of scientific reasoning have a high enough category in the aspect of results and a fairly low category in the process aspect. Student responses can be seen in Figure 2.

![Figure 2. Student opinion](image)

The prior knowledge and collaboration skills of student in developing scientific reasoning can be seen in Figure 3.

![Figure 3. Achievement of prior knowledge and collaboration skills of each indicator](image)

Indicators of collaborative skills consist of 15 skills indicators related to building scientific reasoning, there are 6 skills indicators. Indicators of skills related to building scientific reasoning include productive work, active contributions, compromise and flexible, creative ideas, team building and commitment. The best prior knowledge and collaborative skills in active contribution indicators and the
lowest prior knowledge in team building indicators. Productive work gained a score of 57 for prior knowledge and a score of 59 for collaborative skills including the medium category. Active contribution scores 68 for prior knowledge and 65 for collaborative skills in the medium category. Similarly, in the indicators of compromise and flexible, creative ideas and commitment get a score that belongs to the medium category. In the team building indicator, a score of 32 for initial knowledge and a score of 28 for collaborative skills including is low category.

Student responses at the process, product and result step on interesting topic indicators scored 67, 71 and 74. The questioning skill indicator scored 32, 28 and 28. The future needs indicator scored 43, 46 and 40. The interesting discussion indicator obtained values 68, 62 and 65. Motivation indicators scored 74, 71 and 76. Involving student indicators scored 51, 49, 56 and stimulating discussion indicators scored 31, 28 and 34. Student responses on motivation indicators and interesting topic indicators included in the category high at the process, product and result step. Student responses included in the medium category on the indicator stimulating discussion, involving student, interesting discussions, and future needs. Student responses to indicator questioning skills are low in the process, product and result steps.

Prior knowledge influences scientific reasoning, collaborative skills support scientific reasoning. Prior knowledge has a fairly low correlation with collaborative skills because each of these abilities has a different role in each indicator of scientific reasoning. Prior knowledge is related to scientific reasoning indicators on correlational thinking, proportional thinking, sophisticated proportional thinking and deductive thinking hypotheses. Collaborative skills are related to weight conservation, volume conservation, identification of probabilistic thinking and sophisticated probabilistic thinking [2,5,9]. Prior knowledge in the final test gives good results on each scientific reasoning indicator on the aspects of accuracy, remediation, evaluation and feedback. Prior knowledge at the process and product stages a little help learning activities and affect scientific reasoning student [3,6,11]. However, student who have low prior knowledge about certain topics are not left behind and have difficulty doing scientific reasoning. The feedback aspect is significantly influenced based on prior knowledge and collaborative learning.

The prior knowledge of student greatly provides a role in attending lectures because it supports the ease of student to find, receive and understand new material. Student's prior knowledge influences the learning performance of groups and individuals, the results of lectures each semester, and the speed of completing the study period as the main factors of learning success [17,18]. Student's prior knowledge has a positive correlation with academic achievement. The results of this study indicate there is a correlation between student 'prior knowledge and the achievement of student' academic achievement during elaboration during group discussions. The results of this study indicate that collaboration skills during elaboration of discussions are proven to help student understand new material. Relevant research results show that high prior knowledge really helps student to achieve better academic achievement, whereas low prior knowledge requires student to learn more and require more time in achieving academic achievement [2,4,7,19]. Student with high prior knowledge have basic knowledge that is closely related to concepts that have been discovered after group discussion. Better prior knowledge can provide good direction and provision in further learning. In addition, a positive response to astronomy learning is because it provides contextual knowledge [8,9,12,13,20]. Astronomy learning is closely related to natural phenomena and everyday life.
4. Conclusion
Student's prior knowledge is very important in collaborative learning to foster scientific reasoning. The correlation between prior knowledge and student collaboration skills is quite low. Scientific reasoning indicators are supported by prior knowledge and collaborative skills. Scientific reasoning indicators are correlation thinking, proportional thinking, sophisticated proportional thinking and deductive hypothesis supported by prior knowledge. Scientific reasoning indicators are weight conservation, volume conservation, identification of probabilistic thinking and sophisticated probabilistic thinking supported by collaborative skills. The phase of the process, products and outcome in the learning process are related to building scientific reasoning, including the high category in the aspect of outcome and the quite low category in the process aspect. Aspects of accuracy, remediation, evaluation and feedback provide good results on the final test results at the end of the learning process. Student responses are high on motivation indicators and interesting topic indicators. Student responses to indicator questioning skills are low because of limitations in building scientific reasoning. Prior knowledge can improve the accuracy and mastery of student content to help teachers reduce misconceptions and trigger questioning skills. Scientific reasoning shows that increasing the understanding of concepts and collaborative skills of student depends on prior knowledge of the content and environmental context. Prior knowledge is an identifiable ability related to teacher content knowledge, instruction, and the outcome achieved.

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