
The Role of Practicum in Learning Natural Science

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Abstract: The objective of this research was to find out the perspectives of the students of Faculty of Teacher Training and Education (FKIP) of Riau University (Biology, Physics, and Chemistry), the students of Natural Science Education of State Islamic University of SUSKA (UIN SUSKA) Riau, and the students of Natural Science Study Program of FKIP of Muhammadiyah University of Riau (UMRI) on the role of practicum in learning Natural Science. This research was a Public Opinion Survey Research. The samples were the third semester students who have taken courses; basic biology, basic physics, and basic chemistry. The sample distributions were 2 study groups in each department of FKIP of Riau University, 2 study groups of Natural Science Education of UIN SUSKA Riau, and 2 study groups of Natural Science Study Program of FKIP UMRI. The research instruments were questionnaire and interview. The results showed that the implementation of Natural Science Practicum at three universities and the quality of practicum based on the aspects of planning, implementation, and assessment at the three study programs of FKIP of Riau University were good but not optimal. The Efforts to optimize the quality of Natural Science practicum were the policy making by the faculty leaders related to the regulation and implementation of Natural Science practicum (Biology, Physics, And Chemistry), changing the mindset of students related to the importance of mastering Natural Science practicum in an integrated manner, using learning strategies which directs the students to conduct Natural Science practicum, and the mastery of Natural Science practicum by lecturers, and to familiarize literacy-based science learning.

Keywords: Natural Science learning, Natural Science Practicum

1. Introduction

Learning is the most dominant part in realizing the quality of the education process and graduates. The implementation of good and appropriate Learning will make a positive contribution to students. On the other hand, the implementation of bad learning can complicate the development of the potential and various skills of students. Improving the quality of students is inseparable from the role of educators. Therefore, a Pre-Service Teacher should be equipped with various competencies, especially professional competencies, pedagogical competencies, personal competencies, and social competencies.

The debriefing of the professional competencies of Pre-Service Teachers is more focused on mastering various scientific concepts according to their chosen fields. The mastery of various concepts must be in line with the development of 3 realms, namely cognitive, affective, and psychomotor. The cognitive domain includes knowledge, the affective domain includes attitudes, and the psychomotor domain includes skills. The expected learning is the learning that is able to relate the three domains. Hence, universities as institutions and policy makers must facilitate, motivate, and direct the lecturers to be able to design learning oriented to improving the 3 domains.

The development of learning which combines the 3 domains is quite difficult to do due to the difference in course character. However, various efforts were made continuously to fulfill that intention. One of the efforts made is carrying out a practicum in learning. Zainuddin (2001: 2) asserted

that practicum is a form of teaching that is used to learn together psychomotor abilities (skills), understanding (knowledge), and affective (attitude) using laboratory facilities. Moreover, Rahayuningsih, et al. (2005) added that in order to achieve multi-dimensional objectives in the learning process in the laboratory, so the learning in the laboratory is very effective in achieving the three domains together as follows:

- a. High cognitive skills that can understand the theory, different aspects of the theory can be integrated, and the theory can be applied to real problems.
- b. Affective skills that plan activities independently, collaborate, communicate information related to their fields, and respect their fields.
- c. Psychomotor skills which install the equipment so that it can run properly, use the equipment, and use certain instruments.

Based on the knowledge family as a basis for the development of various subjects, the learning of language and science is a learning that is required to implement practicum. Practicum in language learning can be done in the form of listening and speaking in English, and the creation, theater, and performing arts in the Indonesian language. In general, the practicum of language learning does not require too many tools and materials, but it is important to provide it. In addition, the practicum of learning science can also be categorized based on the division of science itself. Science is divided into social science (IPS) and natural sciences (IPA). The implementation of practicum in social studies learning is also important, it aims to clarify abstract concepts. While in science learning, the existence of practicum is not only to help the lecturers in clarifying concepts, but it is also able to train and develop various competencies of students.

Woolnough and Allsop (Rustaman, et al., 2003) said that there are four reasons of the importance of Natural Science (IPA) practicum activities, namely: 1) Practicum can generate motivation to study Natural Science, 2) Practicum develops basic skills in conducting experiments, 3) Practicum becomes a vehicle for learning a scientific approach, and 4) Practicum supports subject matter. By implementing the practicum, students become more motivated to learn. In addition, practicum gives students the opportunity to increase their curiosity, and want to be able to. Through practicum activities, students can prove the concepts or theories that already exist, and can experience the process or experiment by themselves. Then they can draw conclusions as a support for their understanding of the subject matter so that it will improve the quality of learning (Astuti, 2015). The previous opinion confirms that practicum implementation is needed in the study of Natural Science. Therefore, The implementation of practicum should go hand in hand with learning Natural Science and should be more dominating. This means that in learning Natural Science, the lecturer must direct students to find concepts through learning experiences (practicum). So, they do not just give concepts through memorization to students.

Natural Science (IPA) is one of the subjects in the educational curriculum structure of Junior High School (SMP / MTs). Its goal is that the students can recognize, respond to, and appreciate science and technology, and can instill the habit of thinking and behaving scientifically, critically, creatively, and independently. According to Fauziah (2013: 44) Natural Science education is directed to find and act so that it can help students to gain a deeper understanding of the natural surroundings. Natural Science Education is learning that covers several disciplines such as physics, biology, and chemistry. The three disciplines are interrelated, at the education unit level of Junior High Schools and Madrasah Tsanawiyah (MTs) that use the 2013 curriculum, Natural Science is taught in an integrated manner. Integrated Natural Science learning can be packaged with themes / topics / teaching materials about

discourse that are discussed from various perspectives or scientific disciplines that are easily understood and recognized by students (Purnamasari, S. and Hertien K. S., 2015).

By implementing the integrated Natural Science learning at Junior High Schools, it requires Natural Science teachers to master these three disciplines. The mastery of the three disciplines must cover all aspects, which one important aspect is practicum activities. For example, a biology teacher should not only be able to carry out biology practicum, but also master and be able to carry out chemistry and physics practicum, and vice versa. The ability of a Natural Science teacher in mastering the basic concepts of Natural Science is generally obtained while they were in college. This is due to the existence of basic courses that become their provisions before leading to their respective fields. In the other words, a Biology Pre-service teacher is required to get basic physics and basic chemistry material and practicum. Likewise, a physics pre-service teacher is also required to obtain basic biology and basic chemistry material and practicum. The basic reason is that a Natural Science teacher must master the basic concepts of Natural Science which are composed of a combination of several interrelated scientific disciplines (Physics, Biology, And Chemistry). Thus, it is required for the Pre-service Teachers of Natural Science Department or the Natural Sciences (Biology, Physics, and Chemistry Study) to be able to master the basic concepts of Natural Sciences, especially the basic practicum of Natural Sciences so that they have knowledge in learning Natural Sciences. In addition, especially for pre-service teachers of the Natural Science Department, it is possible for them to teach Natural Science at Junior High Schools after graduating. Hence, the role of Natural Science practicum is very important for Natural Science students and natural science students.

The facts above show that learning Natural Science still needs improvement in all aspects. This is indicated that the Natural Science skills of students and Pre-Service teacher were still low due to the optimal implementation process. Some aspects that can be used as a reference are aspects of planning, implementation, and assessment. The planning aspect includes the readiness of institutions (infrastructure and lecturers / experts), while for the process, the implementation of Natural Science was also still constrained by the quality of lecturers / experts. For assessment, there was no suitable rubric for measuring Natural Science practicum activities. Based on these explanations, the researchers were interested to conduct a research entitled "The Perspectives of the students of Faculty of Teacher Training and Education (FKIP) of Riau University (Biology, Physics, Chemistry Study Program), Natural Science Study Program of UIN Suska Riau, and FKIP Muhammadiyah University of Riau on the Role of Practicum in Learning Natural Science"

2. Methodology

This research was conducted at three universities: 1) Faculty of Teacher Training and Education (FKIP) of Riau University (Natural Science Education, Biology, Physic, and Chemistry Study programs), 2) Faculty of Teacher Training and Education of UIN Suska Riau (Natural Science), and FKIP of Muhammadiyah University of Riau (Natural Science study program). This research was conducted from April to September, 2019. This research was a Public Opinion Survey research. The objective of this research was to find out the students' perspectives the role of practicum in learning Natural Science. The samples were taken by using purposive sampling method. The samples were the third semester students who have taken courses; basic biology, basic physics, and basic chemistry. The sample distributions were 2 study groups in each department of FKIP of Riau University, 2 study groups of Natural Science Education of UIN SUSKA Riau, and 2 study groups of Natural Science Study Program of FKIP UMRI.

The Data obtained was ordinal data taken from the results of the questionnaire and interview. The data were analyzed quantitatively and qualitatively, and were presented descriptively. To obtain relevant

data, the researchers used a questionnaire and interview guidelines as the instruments of the research. Questionnaire and interview guidelines which were designed covered 4 aspects; aspects of the role of practicum in learning Natural science, aspects of practicum planning, aspects of practicum implementation, and aspects of practicum assessment. The data collected was in the form of summative response scale using a modified Likert scale with 4 answer choices. Before the instrument was used, the validation was carried out by expert judgment, lecturers, or experts in the field of psychology. The data obtained from the results of the questionnaire were analyzed quantitatively, while the data obtained from the results of the interviews were analyzed qualitatively.

3. Result and Discussion

The results showed that the implementation of the science practicum at three universities (FKIP UNRI, FKIP UMRI, and FTK UIN SUSKA RIAU) was good but not optimal. This can be explained based on 5 aspects as follows:

- a. *Aspect of Natural Science Course.* It can be concluded that: a) The Natural Science course which was more dominant interested by the students of Natural Science Study Program of FKIP UMRI was Biology (55.56%), b) The Natural Science course which was more dominant interested by the students of Natural Science department of UIN SUSKA RIAU was Biology (53.23%), and c) The Natural Science course which was more dominant interested by the students of Biology Study Program of FKIP UNRI was Biology (71.23%), The Natural Science course which was more dominant interested by the students of Chemistry Study Program was Chemistry and Biology (55.88%), and the Natural Science course which was more dominant interested by the students of Physic Study Program was was physic (60.61%).
- b. *Aspect of Natural Science Practicum.* From this aspect, it can be concluded that: a) The Practicum of Natural Science which was more dominant interested by the students of Natural Science Study Program of FKIP UMRI was physic practicum (44,44%), b) The Practicum of Natural Science which was more dominant interested by the students of Natural Science department of UIN SUSKA RIAU was Biology practicum (53,23%), and c) The Practicum of Natural Science which was more dominant interested by the students of Biology Study Program of FKIP of Riau University was Biology practicum (71,23%), The Practicum of Natural Science which was more dominant interested by the students of Chemistry Study Program of FKIP of Riau University was Chemistry practicum (55,88%), The Practicum of Natural Science which was more dominant interested by the students of Physic Study Program of FKIP of Riau University was Physic practicum (62,12%)
- c. *Aspect of the role of Natural Science Practicum for recent Study Program/Department.* It can be concluded that: a) The Natural Science Practicum that has very important role for the students of Natural Science Study Program of FKIP UMRI was the practicum of Biology, Physic, and Chemistry (50%), b) The Natural Science Practicum that has very important role for the students of Natural Science Study Program of Natural Science Department of UIN SUSKA RIAU was the practicum of Biology, Physic, and Chemistry (50%), and c) The Natural Science Practicum that has very important role for the students of Biology Study Program of FKIP of Riau University was Biology practicum (83,56%), The Natural Science Practicum that has very important role for the students of Chemistry Study Program of FKIP of Riau University was Chemistry practicum (88,24%), dan The Natural Science Practicum that has very important role for the students of Physic Study Program of FKIP of Riau University was Physic practicum (84,85%).

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- d. *Aspect of the benefit of Natural Science for Students' Career.* It can be concluded that: a) The Natural Science practicum which has benefits for the career of students of Natural Science Study Program of FKIP UMRI was Biology practicum (50%), b) The Natural Science practicum which has benefits for the career of students of Natural Science Study Program of Natural Science Department of UIN SUSKA RIAU was the practicum of Biology, Physic, and Chemistry (48,39%), dan c) The Natural Science practicum which has benefits for the career of students of Biology Study Program of FKIP of Riau University was Biology practicum (80,82%), The Natural Science practicum which has benefits for the career of students of Chemistry Study Program of FKIP of Riau University was Chemistry practicum (82,35%), dan The Natural Science practicum which has benefits for the career of students of Physic Study Program of FKIP of Riau University was Physic practicum (84,85%).
- e. *Aspect of the Intention to Deepen Knowledge through Natural Science practicum.* It can be concluded that: a) The practicum of Natural Science that helps the students of Natural Science Study Program of FKIP UMRI to deepen the knowledge was Biology practicum (50%), b) The practicum of Natural Science that helps the students of Natural Science Department of UIN SUSKA RIAU to deepen the knowledge was Biology practicum (45,16%), and c) The practicum of Natural Science that helps the students of Bilology Study Program of FKIP of Riau University to deepen the knowledge was Biology practicum (76,71%), The practicum of Natural Science that helps the students of Chemistry Study Program of FKIP of Riau University to deepen the knowledge was Chemistry practicum (73,53%), dan The practicum of Natural Science that helps the students of Physic Study Program of FKIP of Riau University to deepen the knowledge was Physic practicum (83,33%).

The data above confirm that students of Natural Science study program/ department and Natural Sciences (Biology, Physics, and Chemistry Study Programs) are more dominant interested in studying Natural Science and Natural Science practicum for one field. Especially for Natural Science students (Biology, Physics, and Chemistry), they have a tendency to state that the Natural Science practicum plays an important role in their major. However, Natural Science students (Biology, Physics, and Chemistry Study Program) have a tendency and are more dominant in choosing practicum that are specific to their Study Program. The practicum in learning Natural Science is the processes in science. It proves that practicum has a very important role in learning science (Nuryanti, 2011).

From the aspect of Natural Science practicum that supports students' careers, it can be seen that the different results were found among the students of Natural Science Study Program of FKIP of Muhammadiyah University of Riau, the students of FKIP of Riau University (Biology, Physics, and Chemistry study program), and the students of Natural Science Department of UIN SUSKA RIAU. The students of Natural Science Study Program of FKIP of Muhammadiyah University of Riau and the students of FKIP of Riau University (Biology, Physics, and Chemistry study program) have a tendency and are dominant in choosing one type of practicum to support their careers, while the students of Natural Science Department of UIN SUSKA RIAU have a tendency and are dominant in choosing practicum in biology, physics, and chemistry to support their careers.

We recommend that every IPA student or IPA family must master the learning and practicum of science as a whole. This is due to science learning in integrated SMP / MTs, which wants science teachers to be able to master biology, physics, and chemistry. Therefore graduates of the Department / Study Program / Tadris must master the Natural Sciences (biology, physics, and chemistry). This also applies to graduates of the Department / Study Program / Tadris family of science (study program in biology, physics, and chemistry). Even though the graduates have been specifically plotted to become high school teachers, the science is generally not integrated. But graduates of the Department / Study Program / Tadris group of Natural Sciences have the opportunity to be able to teach in SMP / MTs, so

they must master the whole science. Hodson (1996: 115) asserts that there are three elements in learning science, namely:

Supposedly, every Natural Science student or group of Natural Sciences must master the learning and practicum of Natural Science as a whole. This is due to the integrated science learning at Junior High Schools in SMP / MTs, which wants Natural Science teachers to be able to master biology, physics, and chemistry. Hence, Natural Science graduates are required to master Natural Sciences (Biology, Physics, and Chemistry). This also applies to graduates of the Natural Science Study program / department (Biology, Physics, and Chemistry Study Program). Even though the graduates have been specifically plotted to become high school teachers, in general, the Natural Science course is not taught integrated. However, the graduates of the Natural Science Study Program / Department have the opportunity to be able to teach at Junior High Schools (SMP / MTs) so they can master Natural Science as a whole. Hodson (1996: 115) asserts that there are three elements in learning Natural Science as follows:

- a. Studying Natural Science involves acquiring scientific concepts, and can become familiar with scientific theories.
- b. Learning about science is an understanding of the nature of science and scientific practice with an appreciation of the complex relationships between science, technology and society.
- c. Doing science includes acquiring the knowledge and skills needed to be engraved with scientific inquiry and to be able to use that expertise to conduct true inquiry, both through direct direction under the guidance of the teacher.

Based on aspects of the intention to deepen knowledge through natural science practicum, it can be concluded that the students of Natural Science study programs / departments and groups of natural sciences (Biology, Physics, and Chemistry Study Program), tend to choose one practicum only. It was also emphasized to make efforts to improve the learning of Natural Science at any Universities so that the study of Natural Science is not only partial, but also integrated as a whole. Although currently practicum procedures have not shown the integration of biological, physical, and chemical material, the practicum activities carried out are still focused on one area of Natural Science studies (Umah et al., 2014). Wulandari et al. (2011) added that integrated learning can provide students with a strong foundation for further education studies so that they will show an interest in offering core subjects (Biology, Chemistry, and Physics).

Based on data analysis on the improvement of the quality of Natural Science practicum at three universities which includes aspects of planning, implementation, and assessment, it can be concluded that in general > 60% aspects of planning, > 80% aspects of implementation, and > 85% aspects of assessment, all three Universities get positive responses. Especially for FKIP of Riau University (Biology, Physics, and Chemistry Study Program), in general, > 81% aspects of planning, > 82% aspects of implementation, and > 90% aspects of assessment received positive responses. It can be concluded that the quality of practicum at three universities and three study programs of FKIP of Riau University are in the Good category. For more details, it can be seen in Figure 1 and Figure 2.

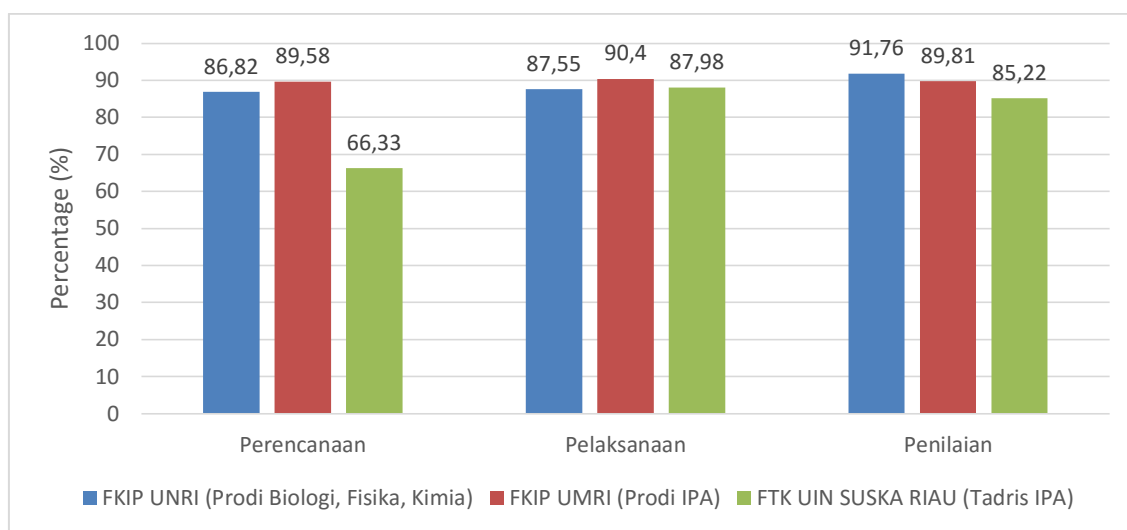


Figure 1. The data of the Improvement of the quality of Natural Science Practicum at three Universities

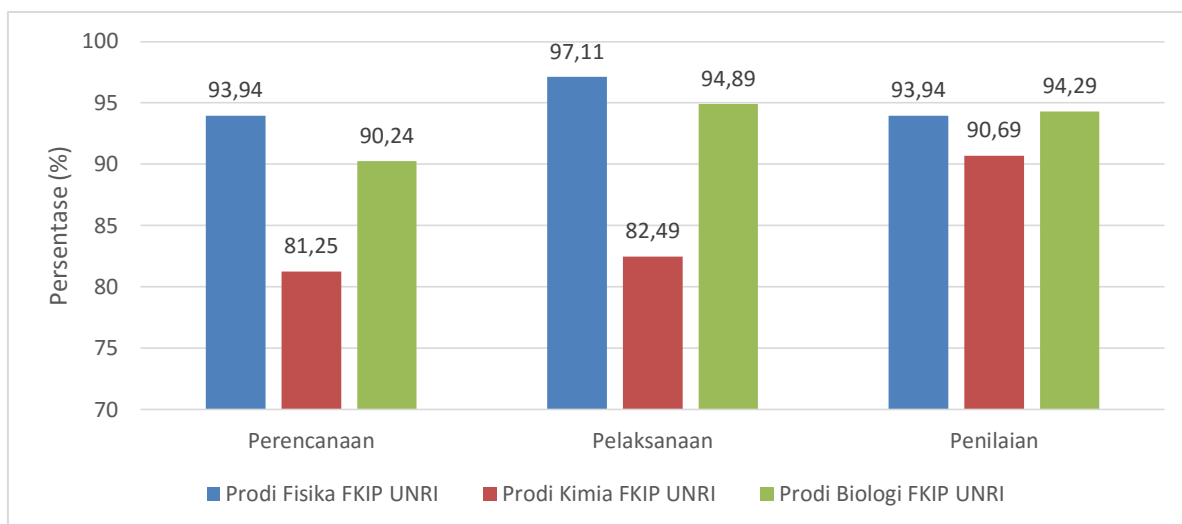


Figure 2. The Data of the Improvement of the Quality of Natural Science Practicum at three Study Programs of FKIP of Ria University (Biologi, Physic, Chemistry Study Program)

Based on Figure 1, it can be explained that the percentage of planning of Natural Science Department of FTK UIN SUSKA RIAU is low because the lecturers rarely use the latest reference books / literature (≤ 5 years), and the practicum schedule is less effective and efficient. In addition, based on Figure 2, It can be seen that the aspect of implementation, in particular, in the Chemistry Study Program of FKIP UNRI, there are still negative responses to indicators of mentoring conducted by lecturers during the practicum taking place. This means that lecturers rarely accompany the students during the practicum.

The data above is also supported by the results of interviews, which explain that the aspects of planning / preparation of natural science practicum at the Natural Science Study Program of the FKIP of Muhammadiyah University of Riau was good (but not optimal). This is due to the incorporation of several practicums in one meeting, limited equipment and materials, and the room is not conducive.

Similarly, at the Natural Science Department of FTK UIN SUSKA RIAU, the implementation of practicum was not on time, the practicum was compacted at the end of the semester, the facilities were inadequate, the purpose of the practicum was not going well, the lecturers did not accommodate the practicum objectives, and did not yet have a laboratory. While at FKIP of Riau University (Biology, Physics, and Chemistry Study Program), the problem was the lack of tools and materials, laboratory equipment had not been upgraded according to the times, and the laboratory was not conducive.

Aspect of the Natural Science practicum implementation at three universities, in general, was also good (but not optimal), this was caused by the limitations of tools and materials, the room was not conducive, and lack of assistance by lecturers during the practicum. Then, aspects of the assessment of natural science practicum at three universities explained that at Natural Science of FKIP Muhammadiyah University of Riau and FTK UIN SUSKA still encountered problems of transparency in practicum scores, the lecturers did not directly assess the results of the practicum, and the assessments did not match student performance. While at FKIP of Riau University, there was no simulation of the material or review of the material before the practical exam.

The above results require an effort to optimize all aspects involving stakeholders. These efforts include policy making by faculty leaders related to the regulation and implementation of Natural Science practicum (Biology, Physics, and Chemistry), changing students' mindset related to the importance of mastering Natural Science practicum (Biology, Physics, and Chemistry) in an integrated manner, applying learning strategies which directs students to conduct science practicum, mastery of science practicum by lecturers, and to familiarize literacy-based science learning. By these efforts, it is expected that Natural Science learning and practicum can run optimally.

4. Conclusion

The implementation of Natural Science practicum at three universities (FKIP UNRI, FKIP UMRI, and FTK UIN SUSKA RIAU) and the quality of practicum based on the aspects of planning, implementation, and assessment at the three study programs of FKIP Riau University were good but not optimal. The Efforts to optimize the quality of Natural Science practicum were the policy making by the faculty leaders related to the regulation and implementation of Natural Science practicum (Biology, Physics, And Chemistry), changing the mindset of students related to the importance of mastering Natural Science practicum (Biology, Physics, And Chemistry) in an integrated manner, using learning strategies which directs the students to conduct Natural Science practicum, and the mastery of Natural Science practicum by lecturers, and to familiarize literacy-based science learning.

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- e. Research Team

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