Improvement mathematical problem’s solving ability of junior high school students by using inquiry models with everyone is a teacher here strategy

R Aminulloh¹, Suhendra¹, and M G Ristiana²

¹ Department of Mathematics Education, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No.229, Isola, Kec. Sukasari, Kota Bandung, Jawa Barat 40154, Indonesia
² Primary Teacher Education, IKIP Siliwangi, Jl. Terusan Jenderal Sudirman, Cimahi 40526, Indonesia

E-Mail: rizal.aminulloh95@student.upi.edu

Abstract. This research is motivated by the need of solving mathematical problem ability and fact that Indonesian students have a low score of solving mathematical problem ability in junior high school. The aims of this research are intended to examine the application of learning by using inquiry models with everyone is a teacher strategy towards achievement and improvement of solving mathematical problem ability of junior high school students. The method used in this research is a quasi-experiment with a non-equivalent experimental design. The population of this research is students of grade eight from one of junior high school in Bandung period 2016/2017. This research’s taken two classes from grades eight, randomly. One class as an experimental class that got learning by using an inquiry model with EITH strategy and one class as a control class that got conventional learning. The result of this research, shown: (1) achievement of solving mathematical problem ability of students who gain learning by using inquiry model with EITH strategy is better than students who gain conventional learning (2) learning mathematic by using inquiry model With EITH strategy be able to improve students’ ability to solve mathematical problem (3) generally, students that got math’s learning by using inquiry models with everyone is a teacher here (EITH) strategy has given positive responses to this learning.

1. Introduction

The purpose of education written in the 1945 Constitution (amendment version), article 31, paragraph 3, states that "the government strives and organizes a national education system, which enhances faith and piety and noble character to improve the life of the nation, which is regulated by law". Besides, Law Number 20 the Year 2003 concerning the National Education System, article 3, states that the purpose of national education is to develop the potential of students to become people of faith and to devote to God Almighty, to have good character, be healthy, to be knowledgeable, capable, creative, independent and become democratic and responsible citizens. Many efforts can be made by the government to realize these educational goals. One of them is through learning mathematics.

One of the aims of mathematics learning is stated in the Education Unit Level Curriculum is to solve problems that include the ability to understand problems, design mathematical models, solve models and interpret the solutions obtained [1–3]. Problem-solving skills are often said to be mathematical competencies, mathematical proficiency is very important for everyone who wants to succeed in learning mathematics [4,5]. Furthermore, mathematical proficiency has five components (aspects)
namely, Conceptual understanding, Procedural fluency, Strategic competence, Adaptive reasoning, and Productive disposition [6].

The above description explicitly implies that the purpose of mathematics learning is to improve reasoning, communication, connections, problem-solving, and application. We can see that the estuary of all these abilities is the problem-solving ability [7]. This is in line with what was teaching mathematics must be used to enrich, deepen, and expand students' abilities in solving mathematical problems [8,9]. Besides, mathematical problem’s solving is one of the mathematical activities that are considered important by both teachers and students at all levels, starting from elementary school through high school [10–15]. The importance of problem’s solving skills in mathematics learning that problem’s solving skills are very important in mathematics, not only for those who will later explore or learn mathematics but also for those who will apply it in other fields of study and daily life [5,16].

However, at present, the ability to solve mathematical problems is still a barrier in learning mathematics in Indonesia. This is marked by the results that have not been received by participants from Indonesia at PISA, explained that in 2015, the population of students in Indonesia aged 15 years who were sampled in taking the test was ranked 63 out of 70 countries [17–20]. The average score of mathematical ability obtained by Indonesia is 386, while the average score of the ability of OECD member countries is 490. The questions in the PISA event take the form of solving problems that are not routine or unusual. Based on this fact it can be concluded that the mathematical problem-solving ability of students in Indonesia who are around 15 years old or the age of students at the junior secondary level is still below the average age of students from other countries. The conclusion of the PISA report is not much different from the results received by Indonesia in the TIMSS study conducted by the International Association for the Evaluation of Educational Achievement (IEA) in 2015 which placed Indonesian VIII grade students in 50th place out of 54 participating countries with an average score of 397 students, while the average international score in the contest was 500 [19,21].

The results received by Indonesia in the PISA or TIMSS above indicate that the mathematical problem’s solving ability of Indonesian students, especially junior high school students, is still not good. One of them may be caused by a learning process that does not require students to be able to solve problems [22–24]. Because of the reality on the ground that researchers observed during observations in several schools, mathematics learning in Indonesia is still focused on textbooks, where the teacher initially explains the material then provides examples of questions which are then discussed together or in other words the learning is still centered on the teacher [25,26]. Also, students are only given mediocre questions in textbooks. The teacher rarely gives irregular questions that stimulate students to solve problems. It also causes the ability to solve mathematical problems to become not honed. This is in line with the opinion of Ruseffendi which states that so far in the process of learning mathematics in the classroom, students generally learn mathematics only told by their teacher and not through exploration activities [27]. Learning like this indicates that students are not active in learning activities, so it is felt less able to improve students' mathematical problem’s solving abilities.

To overcome the problem of the lack of students' mathematical problem-solving abilities caused by the learning process that is still teacher-centered and the lack of student participation or activity in learning, it is necessary to have a learning condition that conditions students active in learning. Teacher-centered learning should be transformed into student-centered learning [28–30]. Students also must often be given problems or problems that are not routine or unusual so they can hone their mathematical problem’s solving skills.

One effort to make the student-centered learning process also makes students active is by preparing models and learning strategies that are appropriate to the objectives to be achieved. One learning model that researchers choose is the inquiry learning model. This learning model is a student-centered learning model that requires students to be active in learning. This learning model is a series of learning activities that fully maximize all students' ability to search and investigate systematically, critically, logically, and analytically so that they can formulate their findings.

In connection with the above statement the teacher is required to choose the right strategy and in line with the inquiry learning model. One strategy that is deemed appropriate to complete the inquiry learning model that can make students active is the active learning strategy type Everyone Is A Teacher Here (EITH). This strategy aims to get class participation as a whole and individually. This strategy
provides an opportunity for each student to act as a "teacher" for his friends. This strategy also makes students who so far do not want to be involved will actively participate in learning.

The problem formulations in this study are as follows: (1) Is the achievement of mathematical problem's solving abilities of students who obtain learning through the use of inquiry models with Everyone is A Teacher Here strategy better than students who obtain conventional model learning?, (2) Is the inquiry model of learning through the use of strategies Everyone is A Teacher Here can enhance students' mathematical problem’s solving abilities?, (3) How do students respond to mathematics learning using inquiry models with the Everyone is A Teacher Here strategy?

Here are some terms that are operationally defined to obtain a common perception of the concepts used in this study. Students' Mathematical Problem’s Solving Ability is an ability to identify, formulate, solve, and interpret problems and problems that are not routine or common in mathematics learning. The Guided Inquiry Model is a series of learning activities that maximally involve all students' abilities to search and investigate systematically, critically, logically, and analytically and the teacher's role is only to guide students with questions that direct students to solve problems. So they can formulate their findings with confidence. Everyone is A Teacher (EITH) Strategy is a learning strategy that requires students to unleash their potential and also requires students to actively participate in learning. Based on the foundation of the theory and framework of thought, as has been described in the above, the hypothesis in the research of this are: (1) Achievement of mathematical problem’s solving abilities of students who obtain learning through inquiry models with the Everyone is A Teacher Here the strategy is better than students who get conventional learning models. (2)Learning through inquiry models with everyone is A Teacher Here strategy can improve students' mathematical problem-solving abilities.

2. Method
The method used in this study is a quasi-experimental design with a Nonequivalent control group [31,32]. This design is almost the same as the pretest-posttest experimental control group design, the difference is only in the design, the research subjects or research participants are not randomly chosen to be involved in the experimental group or the control group. The experimental class in this study was a class that obtained learning using an inquiry model with the EITH strategy, while the control class was a class that carried out learning using the conventional model.

This research took place in one of the State Junior High Schools in Bandung. This research was conducted in the Even Semester 2016/2017 school year. The population in this study were all students in one of Bandung City Middle Schools, West Java Province. The sample in this study were two classes chosen at random from the existing class (class VIII), namely the experimental class (the class that obtained learning using the inquiry model with the EITH strategy) and the control class (the class that obtained conventional model learning).

The instruments used are broadly classified into two types, namely test and non-test instruments. Test instruments in the form of tests of mathematical and non-test problem-solving abilities in the form of observation sheets, questionnaires, and interview guidelines. To analyze the pretest, posttest, and gain score data, we first test the normality of the data and the homogeneity of variance. Then proceed with the two average similarity test for the pretest data, and the two average difference test for the pretest data and the gain score. While the observational data were analyzed descriptively, for the questionnaire results the students' responses were processed using a Likert scale, and for the interview, result data were analyzed descriptively.

3. Result and Discussion

3.1 Result

3.1.1 Data analysis of pretest results of mathematical problem’s solving ability
Based on the data processing of the pretest results, the minimum score ($X_{min}$), maximum score ($X_{max}$), average score ($\bar{x}$), and standard deviation (s) are shown in table 1.
Table 1. Descriptive Statistics of Pretest Scores

| Group    | X_min | X_max | \( \bar{x} \) | s    |
|----------|-------|-------|---------------|------|
| Experiment | 0     | 56.30 | 24.4          | 13.72985 |
| Control   | 0     | 56.30 | 22.4          | 12.57362 |

Note: SMI = 100

Based on Table 1 it can be seen that the mean pre-test score of the mathematical problem’s solving abilities of the experimental class students is 24.4 and the control class is 22.4. The minimum value of the experimental class is the same as the minimum value of the control class that is 0, and the maximum value of the experimental class is the same as the maximum value of the control class that is 56.3.

Table 2. The results of tests of normality, homogeneity, and similarity of pre-test results

| Mathematical Problem’s solving Ability | Shapiro Wilk Test | Levene Test | Independent Sample t-test |
|--------------------------------------|------------------|-------------|--------------------------|
| Experiment                           | 0.94             | 0.597       | 0.498                    |
| Control                              | 0.327            |             |                          |

Based on Table 2 it can be seen that the results of the normality of the pre-test test data for the experimental class and the control class have a Sig = 0.05. It means that the data from the pre-test results of students' initial mathematical problem’s solving abilities in the experimental class and the control class come from populations that are normally distributed. And also it can be seen that the calculation of data homogeneity test pre-test experimental class and control class, both have the value of Sig Based on Mean = 0:05. It means that the data from the pre-test results of the students’ initial mathematical problem’s solving abilities in the experimental class and the control class have the same variance (homogeneous). Then test average similarity using test independent sample t-test. In Table 2 we can see that the calculation test the similarity of two average with Independent Sample T-Test, the value of Sig (2-tailed) = 0:05. This means that the average ability of early solving mathematical problems between the experimental class and control class did not differ significantly. From the results of the average data analysis of the initial tests that have been carried out, it can be concluded that the initial ability to solve students' mathematical problems between the experimental class and the control class is equivalent or the same before being given treatment.

3.1.2 Posttest data analysis results from the mathematical problem’s solving ability
Based on the data processing of the pre-test results, the minimum score (Xmin), maximum score (Xmax), average score (\( \bar{x} \)), and standard deviation (s) are shown in the following table 2.

Table 3. Descriptive Statistics of Post-test Scores

| Group    | X_min | X_max | \( \bar{x} \) | s    |
|----------|-------|-------|---------------|------|
| Experiment | 10:00 | 81.30 | 52.5          | 15.5 |
| Control   | 15.60 | 75.00 | 42.1          | 12.3 |

Based on Table 3 it can be seen that the mean score of the post-test students' mathematical problem’s solving ability of the experimental class is 52.5 and the control class is 42.1. The minimum value of the experimental class is smaller than the minimum value of the control class that is 10 for the experimental class and 15.6 for the control class. While the maximum value of the experimental class is greater than the maximum value of the control class that is 81.3 for the experimental class and 75 for the control class.
Table 4. The results of tests of normality, homogeneity, and similarity of pre-test results

| Mathematical Problem’s solving Ability | Shapiro Wilk Test | Levene Test | Independent Sample t-test |
|---------------------------------------|------------------|-------------|--------------------------|
| Experimentation                       | 0.540            | 0.121       | 0.002                    |
| Control                               | 0.585            |             |                          |

Based on Table 4 it can be seen that the results of the normality of the experimental class and the control class have a Sig ≥ α = 0.05. This means that the results of the post-test results of students’ final mathematical problem’s solving abilities in the experimental class and the control class come from populations that are normally distributed. And it can also be seen that the homogeneity test calculation of Sig Based on Mean α = 0.05, means that the post-test data of students' mathematical problem’s solving abilities in the experimental class and the control class has the same variance (homogeneous). Then a different test of two averages is used using the independent sample t-test. In Table 4 we can see that the calculation of the two average difference tests with the Independent Sample T-Test Sig (2-tailed) <α = 0.05, thus H0 is rejected, meaning that the achievement of the final mathematical problem-solving ability of the experimental class is greater than the class control. Besides, from the table above we can also know that the average range of post-test and pre-test scores of the experimental class is 28 while the average post-test and pre-test scores of the control class are 19.7. Thus from the results of data analysis on average the final test that has been done, it can be concluded that the achievement of mathematical problem-solving abilities of experimental class students who get learning through the use of inquiry models with everyone is a teacher here strategy is better than control classes that get conventional model learning.

3.1.3 Analysis of improvement of mathematical problem’s solving ability

Analysis of the improvement of the mathematical problem’s solving abilities through the calculation of numerical gain or N-gain. This analysis reveals the development of students’ mathematical problem’s solving abilities as a result of the treatment of the experimental class and the control class. Where the experimental class gets the treatment of learning that uses the inquiry model with everyone is a Teacher Here strategy while the control class gets the treatment with conventional model learning.

Table 5. Descriptive Statistics of N-Gain Scores

| Group    | X_{min} | X_{max} | \bar{x} | s  |
|----------|---------|---------|--------|----|
| Experiment| 0.10    | 0.68    | 0.374  | 0.154 |
| Control  | 0       | 0.50    | 0.251  | 0.131 |

Based on Table 5 Score N-Gain minimum experiment class is larger than the minimum score is 0.10 for the control class and experimental class 0 to class control. While the maximum N-Gain score of the experimental class is also greater than the maximum value of the control class that is 0.68 for the experimental class and 0.50 for the control class. From this, it can be seen that the mean N-Gain score of the experimental class is 0.374 which means that the increase in the experimental class is in the medium category, and the control class is 0.251 which means that the increase is in a low category. From these data, it can be seen that increasing the mathematical problem’s solving ability of the experimental class is better than the control class.

Based on Table 6, it can be seen that the results of normality test calculations Sig ≥ α = 0.05. This means that the gain score data of students’ mathematical problem’s solving abilities in the experimental class and the control class come from normally distributed populations. And it can also be seen that the homogeneity test calculation of Sig Based on Mean values α = 0.05. This means that the gain score data of students' mathematical problem’s solving abilities in the experimental class and the control class has the same variance (homogeneous). Then a different test of two averages is used using the independent sample t-test. In Table 6 we can see that the calculation of the two average test differences with the
Independent Sample T-Test Sig (2-tailed) value $< \alpha = 0.05$. Then $H_0$ is rejected, which means an increase in the mathematical problem’s solving ability of the experimental class is better than the control class. Besides that, from the table above we can also know that the average score of the experimental class gain is 0.37, we can know that the criteria for increasing the mathematical problem’s solving ability of the experimental class students are moderate. While the average value of the control class gain score is 0.25, we can know that the criteria for increasing the mathematical problem’s solving ability of experimental class students are low. Thus from the results of data analysis on average the final test that has been done, it can be concluded that increasing the mathematical problem-solving ability of experimental class students who get learning using inquiry models with the everyone is a teacher here strategy is better than control classes that get conventional model learning.

**Table 6.** The results of tests of normality, homogeneity and similarity tests of the N-Gain Score

| Mathematical Problem’s solving Ability | Shapiro Wilk Test | Levene Test | Independent Sample t-test |
|---------------------------------------|-------------------|-------------|---------------------------|
| Experimentation                       | 0.274             | 0.305       | 0.000                     |
| Control                               | 0.582             |             |                           |

3.1.4 Data analysis of observation results of teacher and student activities

Based on observations of teacher and student activities it appears that learning through the use of inquiry models with the EITH strategy is going well because all steps of learning are carried out either by the teacher or by students. This is in line with what the observer said that learning is following the prepared lesson plans. But some things must be considered according to the observer, namely, when students are asked to respond or confirm not all students are involved in the process, only a few students who respond or confirm and this happens in almost all meetings, whereas for the other steps everything goes well and almost all students are involved in the learning sequence.

3.1.5 Analysis of student response questionnaire

After the process of learning mathematics through the use of inquiry models with Everyone Is a Teacher Here strategy in the experimental class ended, all students in the class were given a questionnaire containing 20 statements that had to be answered using five choices with a Likert Scale. All of these statements consist of two indicators of students' responses to learning, namely the first indicator shows students' interest in learning through the use of inquiry models with strategies (EITH) and the second indicator shows students' motivation towards learning through the use of inquiry models with the Everyone is A Teacher Here strategy. The first indicator consists of five positive questions and five negative questions, while the second indicator consists of six positive questions and four negative questions. The results of the recapitulation of the percentage of student questionnaire responses to learning through the use of inquiry models with the EITH strategy are presented in table 7.

**Table 7.** Recapitulation Percentage of student response questionnaire scores

| Aspect                                                                 | Average | Total Average | F     | Percentage | Interpretation          |
|-----------------------------------------------------------------------|---------|---------------|-------|------------|-------------------------|
| Demonstrate student interest in learning through the use of Inquiry Models with the EITH Strategy | 3, 56   | 3, 56 (Positive) | 27 | 92.86      | Almost All/In General   |
| Demonstrate student motivation towards learning through the use of Inquiry Models with the EITH Strategy | 3, 56   |               |      |            |                         |
Based on the overall indicators measured related to student responses to learning through the use of inquiry models with the EITH strategy, the average score of the student response scale on learning is 3.56, which means that the scale score is positively connoted. If the frequency of students who are positive towards learning through the use of inquiry models with the EITH strategy is calculated, 26 out of 28 students are seen so that the percentage obtained is 92.86%. This data shows that almost all students are positive towards learning through the use of inquiry models with the EITH strategy.

3.1.6 Analysis of interview results
Interviews were conducted after the mathematics learning process ended with ten randomly selected students. Based on the results of the interviews, almost all students showed a positive attitude towards the learning used. This is reflected in the many positive answers to the questions posed.

3.2 Discussion

3.2.1 Achievement of Mathematical Problem Solving Capabilities
Based on the pre-test score data the mathematical problem-solving ability is obtained that the average score of the experimental class pre-test results is 24.4 or 24.4% of the ideal score, the highest score of the experimental class is 56.3 and the lowest value is 0. While the average score of the control class pre-test results is 22.4 or 22.4% of the ideal score, the highest value of the control class is 56.3 and the lowest value is 0. From these results, we can see that both classes have the same initial ability. The results turned out to be the same as the results of the two average similarity tests using a t-test in which the results obtained that H0 was accepted. This means that the initial mathematical problem-solving abilities of the experimental class and control class students are the same or equivalent. To find out which class achievement is better, the average pre-test score of the two classes must be compared with the score of the post-test result.

Meanwhile, the results of the post-test mathematical problem-solving ability obtained that the average score of the post-test of the experimental class was 52.5 or 52.5% of the ideal score, the highest score of the experimental class was 81.3 and the lowest value was 10. While the average score of the control class pre-test was 42.1 or 42.1% of the ideal score, the highest score of the control class was 75 and the lowest score was 15.6. After testing the similarity of two averages on the results of the post-test scores of the two classes it was found that H0 was rejected. This means that the final mathematical problem-solving ability of the experimental class and control class students is not the same or significantly different. From these results we know that the achievements of the two classes are different, to find out which is better the achievement then we can see the range between the post-test and pre-test scores of the two classes.

From the results of the pre-test and post-test of the two classes, we can see that the average range of post-test and pre-test scores of the control class is 19.7. While the average range of post-test and pre-test scores of the experimental class was 28.1. We can conclude that the achievement of students’ mathematical problem-solving abilities in the experimental class, which is the class that gets mathematics learning through the use of inquiry models with the EITH strategy, is better than the control class that gets conventional model mathematics learning. The results of the analysis support the research hypothesis that has been made, namely that the achievement of mathematical problem-solving abilities of students who obtain learning through the use of inquiry models with everyone is A Teacher Here the strategy is better than students who obtain conventional learning models.

3.2.2 Improved Mathematical Problem Solving Capability
Based on the pre-test and post-test score data results of mathematical problem-solving abilities, we can obtain again score for both classes. From the results of the study, it was found that the average gain score of the experimental class was 0.37. The highest gain score of the experimental class was 0.68 and the lowest score was 0.10 while the average gain score of the control class was 0.25. The highest gain score of the control class is 0.5 and the lowest value is 0. From these data, we can know that in general, the improvement of mathematical problem-solving abilities of experimental class students is in the medium category. Individually 63.2% of students in the experimental class gained increased
mathematical problem-solving abilities in the medium category. While 36.8% of students gained improved mathematical problem-solving skills in the low category. Meanwhile, in the control class, 31.6% of students gained an increase in mathematical problem-solving abilities in the medium category. Whereas 68.4% of students gained improved mathematical problem-solving skills in the low category. Based on the data we have obtained, we can surmise that the mathematical problem-solving ability of experimental class students who get learning through the use of inquiry models with the EITH strategy has a higher increase than the control class that gets conventional model learning.

After testing the difference in two averages on the results of the gain scores of the two classes, the result is rejected H0. This means that the analysis of the results of the post-test mathematical problem-solving ability of the experimental class and the control class can be seen that there are significant differences in the average Gain score between the experimental class and the control class. Besides, from Table 5 we can know that the average score of the experimental class gain is 0.37 with the criteria for increasing the mathematical problem-solving ability of the experimental class students is moderate. While the average value of the control class gain score is 0.25 with the criteria for increasing students' mathematical problem-solving ability of the experimental class is low.

Thus from the results of data analysis on average the final test that has been done, it can be concluded that increasing the mathematical problem-solving ability of experimental class students who get learning through the use of inquiry models with the everyone is a teacher here strategy is better than the control class that gets conventional model learning. The results of the analysis support the research hypothesis that has been made, namely that increasing the ability to solve mathematical problem-solving students who obtain learning through the use of inquiry models with everyone is A Teacher Here the strategy is better than students who obtain conventional learning models.

3.2.3 Student Responses to Learning Through the Use of Inquiry Models with the EITH Strategy

The purpose of further research is to see how students respond to mathematics learning through the use of inquiry models with the EITH strategy. Of the 20 statements with two different indicators namely students' interest and motivation towards learning through the use of inquiry models with the EITH strategy that has been given. In the first indicator, it is known that the average score of the students' response scales on the first indicator is 3.56. This means that the category of student responses that showed interest in learning through the use of inquiry models with the EITH strategy expressed positive responses. Not much different from the first indicator, the second indicator is known on the average scale score of students' responses on the indicator that is 3.56. This means that the categories of student responses that show motivation for learning through the use of inquiry models with the EITH strategy express positive responses.

In general, the results of the questionnaire analysis of student responses to learning showed that the average score scale of student responses to this learning was 3.56. This means that the average respondent or student in the experimental class expressed a positive attitude towards learning mathematics through the use of inquiry models with the EITH strategy. From the analysis of the results of the questionnaire responses of students also obtained as many as 92.86% of students have positive responses. This means that in general students show positive responses to mathematics learning through the use of inquiry models with the EITH strategy. From the description above we know that students generally show positive responses to learning through the use of inquiry models with the EITH strategy. This is also shown by the results of observations of teacher and student activities as well as interviews conducted with students.

4. Conclusion

Based on the results of research and discussion conclusions can be obtained as (a) achievement of mathematical problem’s solving abilities of students who obtain mathematics learning with the inquiry model with the Everyone is A Teacher Here (EITH) strategy is better than students who obtain mathematics learning with conventional models; (b) Mathematics learning through the use of inquiry models with Everyone is A Teacher Here (EITH) strategy can improve students' mathematical problem’s solving abilities; (c) In general, students who obtain mathematics learning through the use of inquiry models with the Everyone is A Teacher Here (EITH) strategy are positive towards the learning, which
is characterized by student enthusiasm during learning, high interest, and motivation, and a sense of pleasure, as a result, follow the learning in class.

5. Acknowledgments
In the preparation of this research cannot be separated from the help of various parties. Therefore, with all humility, the writer would like to express his deepest gratitude to Mrs. Lina Marlina Sadeli, S.Pd, M.M. as Deputy Principal of SMP Negeri 7 Bandung in the field of the curriculum which has allowed the author to conduct research and Students of SMP Negeri 7 Bandung, especially Class VIII C and VIII D who have helped a lot in research.

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