



# Group mentoring of youth scientists to enhance the students' research literacy

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ARTICLE INFO	ABSTRACT
<p><b>Article history</b>            Received: 2023-05-17            Revised: 2023-05-19            Accepted: 2023-05-27            Published: 2023-07-02</p> <p><b>Keywords</b>            Research literacy            Scientific skills            Youth scientific group</p>	<p><i>The Youth Scientific Group (YSG) is an extracurricular activity that has a positive impact on students. Unfortunately, the presence of YSG in various schools, including SMAN 1 Tumpang, is still not optimal. In this high school located in Malang Regency, the YSG activities have not been carried out consistently. The scientific competence and research literacy of students at SMAN 1 Tumpang have not been fully utilized. In response to this issue, the aim of the Community Science and Technology Program (Community Service Program) is to enhance the scientific competence and literacy of students at SMAN 1 Tumpang through mentoring in the preparation of YSG. This Community Service Program consists of several stages, including observation and problem identification, preparation of YSG mentors, material presentation, training and mentoring, activity evaluation, and the preparation of scientific articles as program outputs. The average pretest score of the students' knowledge was 39.67, while the posttest score increased to 93.23. The average N-gain of their knowledge reached 0.836. Based on this N-gain value, the students' knowledge improvement is categorized as high. The paired t-test results indicate a significant difference in students' knowledge related to scientific work before (M = 39.7, SD = 20.6) and after the program (M = 93.2, SD = 7.5), t(30) = 14.6, p &lt; .001. Therefore, the program implemented in the partner school has proven to be beneficial in enhancing students' scientific competence.</i></p>
<p><b>Kata Kunci</b>            Kelompok ilmiah remaja            Keterampilan ilmiah            Literasi penelitian</p>	<p><b>Pendampingan kelompok ilmiah remaja untuk meningkatkan literasi penelitian siswa.</b> Kelompok Ilmiah Remaja (KIR) merupakan kegiatan ekstrakurikuler yang memberikan dampak positif bagi siswa. Sayangnya, keberadaan KIR di berbagai sekolah masih belum optimal, salah satunya di SMAN 1 Tumpang. Di SMA yang terletak di Kabupaten Malang ini, kegiatan KIR masih belum berjalan secara berkelanjutan. Kompetensi ilmiah serta literasi penelitian siswa SMAN 1 Tumpang masih belum terberdayakan dengan optimal. Menanggapi permasalahan tersebut, tujuan kegiatan pengabdian Program IPTEK bagi Masyarakat (Pengabdian kepada masyarakat) ini adalah untuk meningkatkan kompetensi ilmiah dan literasi Siswa SMAN 1 Tumpang melalui pendampingan penyusunan KIR. Kegiatan Pengabdian kepada masyarakat ini terdiri dari beberapa tahapan, yaitu observasi dan identifikasi permasalahan, penyiapan pendamping KIR, pemaparan materi, pelatihan dan pendampingan, evaluasi kegiatan, serta penyusunan artikel ilmiah sebagai luaran program. Rerata pretest pengetahuan mahasiswa adalah sebesar 39,67 sedangkan posttestnya meningkat menjadi 93,23. Rerata N-gain pengetahuan mereka mencapai 0,836. Didasarkan pada angka N-gain tersebut, maka peningkatan pengetahuan siswa berkategori tinggi. Hasil uji t berpasangan menunjukkan bahwa ada perbedaan besar yang signifikan antara pengetahuan siswa terkait karya ilmiah antara sebelum (M = 39.7, SD = 20.6) dengan setelah program (M = 93.2, SD = 7.5), t(30) = 14.6, p &lt; .001. Dengan demikian, program yang telah dilaksanakan di sekolah mitra terbukti mampu memberikan manfaat terhadap peningkatan kompetensi ilmiah siswa.</p> <p style="text-align: right;">Copyright © 2023, Fauzi et al.            This is an open access article under the <a href="https://creativecommons.org/licenses/by-sa/4.0/">CC-BY-SA</a> license</p> <div style="text-align: right;"></div>

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## INTRODUCTION

The Youth Scientific Group (YSG) is a form of extracurricular activity that provides benefits to high school students. Through YSG activities, students are introduced to the scientific method, enabling them to learn research skills and enhance their scientific competence (Duc et al., 2022; Irwanto, 2022; Yeoman & Zamorski, 2008). With YSG activities that involve training students in writing research papers, their literacy and writing skills will also be empowered (Prahmana, 2017). In line with these benefits, their scientific attitude will also improve as they gain more research experience (Irwanto, 2022). Additionally, the opportunity to participate in YSG competitions will provide them with competitive experiences and prepare them to compete at higher levels of education.

By fostering research and scientific writing practices, the 21st-century skills of students can be effectively empowered (Turiman et al., 2012). Students will become accustomed to critical and creative thinking as they identify problems and seek solutions during the process of composing scientific works (Campo et al., 2023). They will also enhance their communication skills through writing activities (Fauzi & Ramadani, 2017). Furthermore, their collaboration skills can be maximized as the YSG activities require students to work together in groups to create their works.

Unfortunately, despite providing various benefits to students, the implementation of YSG activities in many schools has not been optimal. In fact, many schools do not offer YSG as one of the extracurricular activities for students. The lack of student motivation, absence of YSG mentors or supervisors, busy school schedules, and inadequate supportive facilities are some of the reasons why YSG is not running optimally in most schools (Asmara & Kusumaningrum, 2020; Saidah & Rahmah, 2020). Additionally, the unfamiliarity of students with research activities and scientific writing also hinders the development of YSG in schools (Syam et al., 2021). Moreover, the culture of research and scientific publication among teachers in many schools has not been well-established (Indrawat et al., 2021; Permana et al., 2022).

One of the schools where the implementation of YSG is not optimal is SMAN 1 Tumpang. Despite consistently being ranked among the top three schools in various aspects in the Malang Regency area, the YSG activities in this school have yet to become apparent. Therefore, YSG activity assistance activities need to be initiated at this school.

The mentoring program for YSG activities is not a new practice in various regions. Several publications have reported similar activities in places such as Kupang (Syam et al., 2021), Denpasar (Dharmawan et al., 2020), Magelang (Asmara & Kusumaningrum, 2020), Tulungagung (Madayan, 2022), Jombang (Ami et al., 2021), Kutai Kartanegara (Pratama & Casmudi, 2019), and Gresik (Saidah & Rahmah, 2020). The program is not only implemented at the high school level (Asmara & Kusumaningrum, 2020; Syam et al., 2021) but also in junior high schools (Saidah & Rahmah, 2020). However, the presence of mentoring programs for YSG activities in the Malang Regency area is still rare. Furthermore, many schools have yet to fully grasp the essence of scientific work. Therefore, the aim of this community service program is to provide mentoring for YSG activities in this school through the Community Science and Technology Program scheme. Through this community service program, the scientific competence of students at SMAN 1 Tumpang can significantly improve.

In a broader context, the mentoring program for YSG activities in SMAN 1 Tumpang is closely related to Sustainable Development Goals (SDGs). In this regard, the mentoring program contributes to the achievement of several SDGs, such as Quality Education (SDG 4) by enhancing students' literacy and scientific competence (Marchaim, 2001; Queiruga-Dios et al., 2020), and Gender Equality (SDG 5) by providing equal opportunities for all students to engage in YSG activities. Furthermore, the mentoring program for YSG activities also promotes innovation and industrial development (SDG 9) by nurturing students' potential in the field of science and research. Through these efforts, it is expected that the mentoring program for YSG activities in SMAN 1 Tumpang can be part of a collective endeavor to realize the agenda of sustainable development and make a meaningful contribution to a better future.

## METHOD

### Observation

The initial activity required in this community engagement program is to observe the condition of SMAN 1 Tumpang as an effort to identify various issues related to the suboptimal nature of YSG activities in the school. SMAN 1 Tumpang is the only public high school in Tumpang District. It is located at Jalan Kamboja, number 10, Malanguko Village, Tumpang District, Malang Regency. The location map of SMAN 1 Tumpang is presented in Figure 1. This accredited A school has been established since 1978 and has approximately 10 parallel classes in each grade level. In addition to observation, interviews were conducted with the vice principal for curriculum and teachers to obtain information regarding the barriers and opportunities for students in developing YSG.

### Problem Identification and Solution Preparation

After the observation activity, the preparation for YSG mentoring was carried out. This activity aimed to select several volunteers who were willing to become mentors in providing training for YSG preparation to the students. The objective of this activity was to generate a minimum of two qualified volunteers who could provide mentoring alongside the Community Service team to the students of SMAN 1 Tumpang.

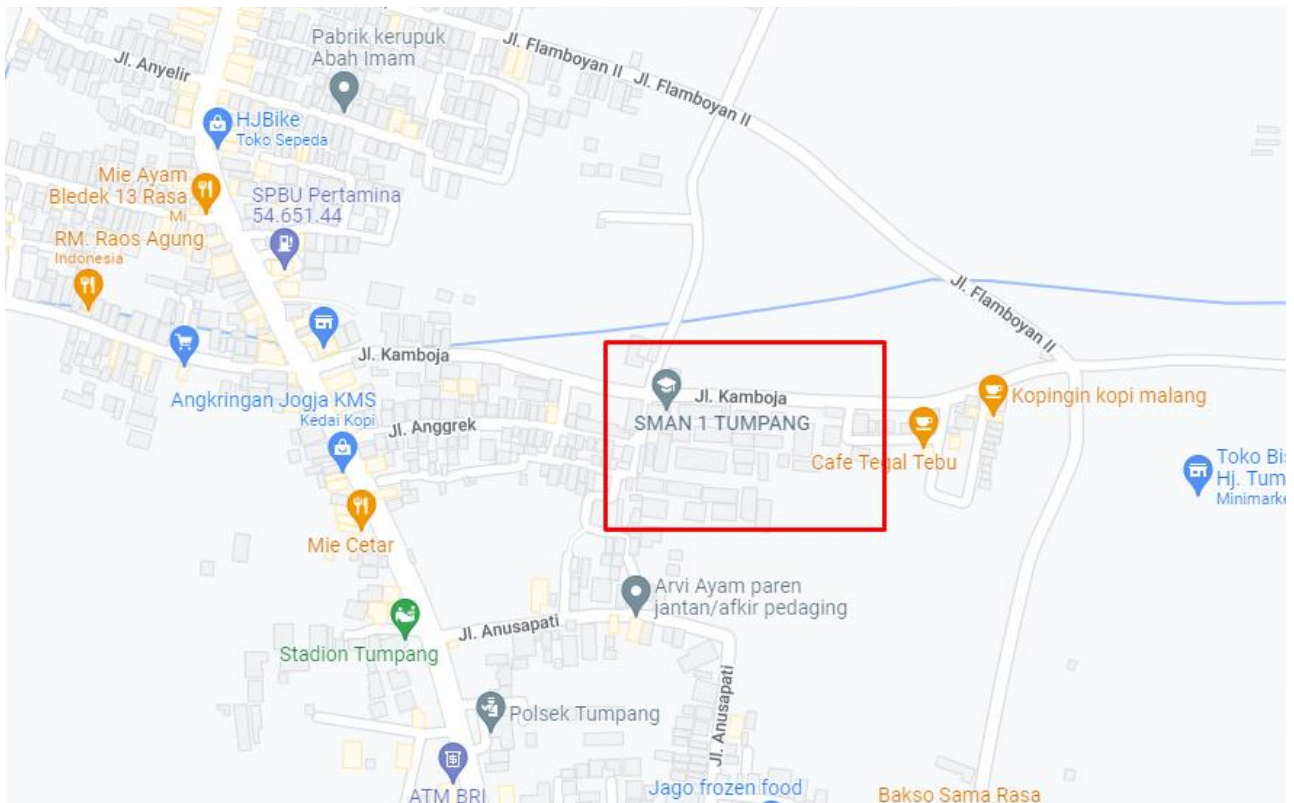


Figure 1. Location of SMA 1 Tumpang

### Workshop and Mentoring

The next activity is the material presentation and training. The essence of this activity is that students will acquire knowledge and receive mentoring and training in developing scientific works. The expected number of YSG mentors participating in this mentoring is two individuals who are capable of accompanying the student team. Students will be provided with materials on the stages of scientific work preparation according to the scientific method. Subsequently, students will be given time and opportunities to create or develop scientific works together with their mentors based on their respective fields of interest.

The participation provided by the partners in the implementation of this community service program includes: 1) providing human resources, namely the students, to serve as participants in the mentoring of scientific writing; and 2) providing suitable facilities and spaces to ensure the smooth execution of the community service activities.

### Program Evaluation

In the scientific publication of this community service project, data analysis was conducted to assess the impact of the implemented program. Data collection took place at the beginning (pretest) and end (posttest) of the activities. The data collection instrument used was a questionnaire consisting of 10 items that assessed literacy related to scientific works. The response options for each statement were: correct, incorrect, and unsure. The collected data were then analyzed using percentage calculations to determine the percentage of students' accurate responses for each item. Furthermore, N-gain analysis was employed to examine the improvement in literacy. Lastly, paired t-test analysis and effect size calculation were performed to analyze the significant influence of the community service program and the extent of its impact on student competence.

## RESULTS AND DISCUSSION

### Observation

Based on the observations made at the school, the school environment and facilities are capable of facilitating various scientific activities, although their utilization is not yet optimal. According to the explanation from the Vice Principal of the Curriculum, the main causes for the limited development of YSG in this school are the lack of student motivation and insufficient facilities to introduce and delve into YSG. Nonetheless, the school authorities are hopeful that the YSG activities will grow and thrive at SMAN 1 Tumpang. In addition, the knowledge and experience of students and teachers in conducting scientific research is still one of the reasons for the suboptimal activity of YSG.

### Problem identification and Solution Preparation

Based on the results of observations, the main problem in partner schools is the lack of assistance for YSG activities. In addition, the knowledge of students and teachers regarding scientific work is still not optimal. Therefore, the community service team needs to design the right YSG assistance for the school.

The initial activity conducted in this community engagement program was a discussion and alignment of perceptions among the members of the engagement team. The team members consisted of four lecturers from two universities and two students from one university. During this activity, the program framework was refined, data collection instruments were finalized, and follow-up plans were prepared. Following the completion of this activity, discussions and alignment of perceptions were conducted with the partner school involved in the engagement program. Discussions and alignment of perceptions with the partner school were conducted both indirectly and directly. Indirect discussions were carried out through communication technology, while direct discussions and alignment of perceptions took place in Tumpang. These activities involved the Indonesian language teachers and the vice principal in charge of the curriculum. Through these activities, the timing and location for implementing the community engagement program could be determined optimally.

### Workshop and Mentoring

The implementation of the program at the partner school was conducted in November 2022. A total of 31 students, several YSG mentoring teachers, and teaching assistant students participated in the activity. During the event, the community engagement team provided guidance, materials, and shared experiences with the partner school regarding research design to scientific publication. Documentation of the activity is presented in Figure 2.



**Figure 2.** Documentation of Community Service Activities at SMAN 1 Tumpang: a. Opening by the principal; b. delivery of material about youth scientific groups; c. Discussion and assistance regarding the search for scientific publications; d. Closing of community service activities

During the delivery of the material, the community engagement team emphasized that scientific research activities conducted by students during the YSG program do not always have to be complex research requiring significant funding and a long duration. There are various simple yet high-quality research designs that can serve as alternatives for students participating in the YSG program. In response to the presented material, the mentoring teachers attending the workshop asked, "How can we enhance students' interest in scientific writing and research in high schools?" Addressing the question, the community engagement team explained that an interest in the scientific field does not emerge spontaneously without being cultivated and facilitated. Therefore, high school students need to be accustomed to conducting simple scientific research and writing, as well as being involved in various scientific forums and seminars.

During the program implementation, one of the participating students also inquired about how to access various scholarly references. In response to this question, the community engagement team immediately demonstrated the practical way to access various scholarly references using Google Scholar. Lastly, another student participant raised the question, "Are we allowed to use data from other researchers and present it as our own research data?" Regarding this inquiry, the community engagement team explained that we are not permitted to use data from other researchers as our own research data unless our study is a literature review.

**Program Evaluation**

After the community engagement activities were conducted, the students' literacy regarding scientific research significantly improved. Table 1 presents the percentage change in their literacy from before to after participating in the community engagement program. Based on Table 1, the accuracy of the students' answers showed an improvement across all the items queried. During the pretest, none of the students' answer accuracy reached 60%. Conversely, during the posttest, almost all items exhibited an answer accuracy percentage above 90%.

**Table 1.** Percentage of accuracy of students' Pretest and Posttest answers

No	Statement Items	Pretest		Posttest	
		Number of correct answers (n)	Percentage (%)	Number of correct answers (n)	Percentage (%)
1	Conducting research and writing scientific papers is not only beneficial for students but also important for university students, teachers, and professors.	17	54.84	31	100.00
2	Scientific papers are works produced from research activities.	17	54.84	31	100.00
3	Research should originate from a problem.	10	32.26	31	100.00
4	The types of data in quantitative and qualitative research differ.	7	22.58	30	96.77
5	In experimental research, there are dependent variables, independent variables, and control variables.	4	12.90	14	45.16
6	Research does not have to be conducted solely in a laboratory.	18	58.06	31	100.00
7	Research can be conducted solely in front of a laptop (without fieldwork).	11	35.48	31	100.00
8	Some examples of scientific references include books, articles in seminar proceedings, and journal articles.	18	58.06	31	100.00
9	Several components that should appear in a scientific paper are introduction, methodology, results, and references.	6	19.35	29	93.55
10	When writing a scientific paper, citations and references must follow the specified format (cannot be arbitrary).	15	48.39	30	96.77

After calculating the percentage for each item, the mean and N-Gain calculations for literacy data between the pretest and posttest were also conducted. The summary of mean and N-Gain calculations is presented in Table 2. Based on Table 2, the pretest mean of students' knowledge was 39.67, while it increased to 93.23 in the posttest. The mean N-Gain of their knowledge reached 0.836. Based on this N-Gain value, the improvement in students' knowledge is categorized as high.

**Table 2.** Increasing students' scientific work literacy

Student	Pretest	Posttest	N-gain
1	30	90	0.857
2	40	100	1.000
3	20	90	0.875
4	20	100	1.000
5	40	100	1.000
6	40	90	0.833
7	30	80	0.714
8	10	80	0.778
9	60	100	1.000
10	30	100	1.000
11	50	100	1.000
12	30	90	0.857
13	50	90	0.800
14	20	100	1.000
15	40	90	0.833
16	50	100	1.000
17	50	70	0.400
18	50	100	1.000
19	100	100	0.000
20	50	100	1.000
21	60	100	1.000
22	30	90	0.857
23	10	100	1.000
24	30	90	0.857
25	90	90	0.000
26	40	90	0.833
27	30	90	0.857
28	20	90	0.875
29	50	90	0.800
30	10	90	0.889
31	50	100	1.000
<b>Mean</b>	<b>39.677</b>	<b>93.226</b>	<b>0.836</b>

In addition to analyzing the data using N-Gain, paired t-tests were also conducted to determine whether there was a significant improvement in students' competencies. Based on Table 3, the results of the paired t-test indicate a significant and substantial difference in students' knowledge regarding scientific work between before (M = 39.7, SD = 20.6) and after the program (M = 93.2, SD = 7.5),  $t(30) = 14.6$ ,  $p < .001$ .

**Table 3.** Summary of paired t-test results of student competencies related to scientific work

Parameter	Value
sample size	31
t	14.60
p-value	3.55E-15
effect size	2.62

Based on the pretest data, it is evident that a substantial number of students at SMAN 1 Tumpang lack a proper understanding of scientific work. This finding highlights the existing gap in their knowledge and indicates the need for targeted interventions to enhance their comprehension. This finding emphasizes the critical importance of addressing these deficiencies and promoting scientific literacy among high school students. Improving students' understanding of scientific work is crucial for several reasons. Firstly, it enables them to critically evaluate and interpret scientific information, fostering their analytical and problem-solving skills. Secondly, it equips them with the necessary tools to engage in scientific inquiry and contribute to the advancement of knowledge in their respective fields. Additionally, a solid foundation in scientific literacy prepares students for higher education and future careers that require a strong understanding of scientific principles.

By identifying the gaps in students' knowledge and implementing targeted interventions, such as the program conducted in this study, educators can effectively address these deficiencies. The program's focus on enhancing students' knowledge of scientific work, research methodologies, and critical thinking skills has demonstrated promising results, as indicated by the significant improvements observed in the posttest scores. These outcomes affirm the effectiveness of the intervention in bridging the gap and nurturing scientific literacy among the participating students.

In addition, the experience of teachers is another significant barrier that hampers their ability to design YSG activities. The limited training available for YSG mentoring for teachers and schools is also another factor that hinders teachers from effectively supporting YSG activities in the school environment. However, despite facing these obstacles, the analysis results demonstrate that community engagement activities have a significant positive impact on student literacy. This program successfully enhances students' understanding of scientific research and provides them with opportunities to engage in research activities relevant to their fields of study. This is reinforced by the observed changes in students' literacy scores from pretest to posttest, as well as the significant improvement in students' accuracy in various aspects related to scientific research.

These findings suggest that through community engagement activities, appropriate approaches, and adequate support, the barriers faced by teachers and students in designing and implementing YSG activities can be overcome. By strengthening collaboration between universities, schools, and communities, and providing relevant training and sufficient resources, we can enhance students' literacy in scientific research and prepare them to tackle challenges in the academic and professional world in the future.

Regarding the problems of partner schools raised in this community service activity, YSG activities are important activities for students. The experience and competence in conducting research play a crucial role for high school students. Firstly, through research experience, students can develop critical skills necessary for evaluating and analyzing information in-depth (Ridlo et al., 2020; Susiani et al., 2018). Critical thinking skills are one of the main competencies that must be empowered in the current era (Abrami et al., 2014; Crowley, 2015; Scott, 2015). In the process of research, students learn to collect data, analyze findings, and draw conclusions based on evidence. These abilities provide them with a strong foundation for problem-solving and making informed decisions (Haenilah et al., 2021; Srikoon et al., 2014).

Moreover, research experience helps students develop effective communication skills. Communication skills are also essential skills in the 21st Century (Chalkiadaki, 2018; Geisinger, 2016). The research process involves writing reports, delivering presentations, and sharing findings with others. Through these experiences, students learn to articulate their ideas clearly and convincingly. Through such research experiences, their communication skills can improve (Prahmana, 2017). Strong communication skills are highly valued in the realms of education and career (Chhinzer & Russo, 2018; Donald et al., 2018; Jackson, 2013), as they enable students to share their knowledge and ideas with others effectively.

Beyond the academic benefits, research experience provides students with valuable opportunities to develop leadership, teamwork, and time management skills. In research projects involving groups, students learn to collaborate with others, share responsibilities, and respect the contributions of each team member. They also acquire the ability to effectively manage their time and resources to successfully achieve research goals.

## CONCLUSION

This paper reports on community engagement activities conducted at SMAN 1 Tumpnag. Discussions, alignment of perceptions, provision of materials, and mentoring have been carried out to assist partner schools in initiating YSG activities in the school. Following the community engagement activities, a significant improvement in students' competence in scientific research has been observed from before participating in the community engagement activities to after participating in them. As a follow-up effort to the program, it is recommended to maintain active mentoring at SMAN 1 Tumpang to ensure the continuity of YSG planning and implementation activities. Mentoring activities can also be conducted through online discussion forums and continued offline activities at the partner school. Additionally, the development of a module that can serve as a guide for YSG activities at the school is necessary.

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