

## The effect of reading-concept mapping-reciprocal teaching on students' communication skills

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### ABSTRACT

Communication skills are one of the abilities required for 21st-century learning. Students must consider communication skills in learning because they can guide students in conveying ideas effectively and interacting and collaborating with others. This study aimed to investigate the online reading-concept mapping-reciprocal teaching (REMAP-RT) learning model on students' oral and writing communication skills. The pretest-posttest control group design was employed in this study with three Biology Education Study Program classes at the State Islamic University in Tulungagung, Indonesia. This study included 89 students separated into three classrooms, each learning using one of three methods: i) REMAP-RT, ii) reciprocal teaching (RT), and iii) discussion-presentation. A questionnaire was used to assess students' oral and written communication skills. Analysis of covariance (ANCOVA) was used to compare differences in communication skills among the three treatment groups based on the questionnaire responses. The research findings revealed that students' oral and writing communication abilities improved across the board, with students in the REMAP-RT class showing the most substantial increase. This result of the research suggests that REMAP-RT improves students' oral and written communication skills in online learning.

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## 1. INTRODUCTION

Communication skills are paramount in education, as they play a pivotal role in facilitating the attainment of learning objectives [1], [2]. These skills are instrumental in equipping students with the necessary tools to thrive in their future professional endeavors [3], [4]. At tertiary institutions, students can effectively communicate their ideas, information, and perspectives through oral and written means. Communication skills enable students to engage in meaningful exchanges with others, facilitating a comprehensive understanding of their thoughts [5], [6]. Practical communication skills are essential to facilitate interaction and foster collaboration [6]. College students must exercise communication skills in various places to avoid misunderstandings and problems [6]. Strong communication skills can be a provision for college students to enter the world of work [3], as most occupations necessitate interpersonal engagement [7]. Hence, cultivating oral and written communication skills is vital in formulating the contemporary educational curriculum for the 21<sup>st</sup>-century [3], [8].

Previous research has effectively demonstrated the significance of acquiring communication skills. However, there is a tendency to overlook the development of these skills in educational settings, resulting in

university students needing more proficiency in their execution [9]. An illustrative instance can be found in the study conducted by Hayat *et al.* [10], which revealed that the lifelong learning profile of students in Indonesia remained relatively deficient, particularly in terms of communication skills. Multiple factors might contribute to a decrease in student participation during classroom discussion activities [11]. Student engagement in exchanging ideas and opinions could have been much better, resulting in a learning process primarily focusing on knowledge transfer [11]. The findings of a separate study indicated that preservice biology teachers exhibited weaknesses in their verbal and nonverbal communication skills [12]. The study found that the teachers demonstrated subpar performance across various aspects of communication skills, including but not limited to questioning, responding to questions, delivering oral presentations, engaging in group interactions, and presenting ideas in a classroom setting [12]. According to research, the achievement of communication skills tends to be low due to students' passive activities, and lack of interest in reading. Therefore, educators should focus on enhancing college students' communication skills.

Educators can enhance students' communication skills by implementing structured learning designs, whether online or offline. Many online learning platforms have incorporated features to facilitate oral and written communication activities. However, it is worth noting that these platforms need to demonstrate sufficient efficacy in supporting effective communication [13]. According to scholarly research, implementing well-structured online learning programs in the classroom can enhance students' communication skills [13]. Besides, developing students' communication skills can be facilitated by creating a social environment that enables them to interact and communicate with their peers or educators [14]. This social environment can facilitate the exchange of ideas, thoughts, and information among students, thereby enhancing learning efficiency through communication media [14], [15]. Hence, educators must devise instructional frameworks facilitating student engagement and communication with peers and instructors via accessible communication functionalities. An instructional approach that has the potential to support this process is online-based cooperative learning.

Cooperative learning has been recognized as a pedagogical tool that can positively influence students' communication skills [16]. Cooperative learning designs allow students to engage in interactive collaboration, collective problem-solving, substantive discourse, and mutual support, thereby fostering shared objectives within a group setting [17]. Communication and interaction among group members are crucial factors for success in cooperative learning [18]. This instructional framework aims to enhance student's abilities to effectively communicate and collaborate with their peers while working on learning assignments [16]. One potential cooperative learning model that can enhance college students' communication skills is reading-concept mapping-reciprocal teaching (REMAP-RT).

The REMAP-RT learning model comprises several stages of learning, namely reading, concept mapping, generating questions, predicting answers, and clarifying information [19]. The first phase of REMAP-RT involves engaging students in communication through reading activities [5]. Reading contributes to developing students' prior knowledge, enabling them to communicate information clearly and coherently effectively [20]. The ability to convey information to others is part of communication skills [5]. This reading stage is carried out asynchronously. Students are allowed to access the internet and search for literature and various information related to learning material. This activity will enrich students' knowledge and support the development of their communication skills.

During the stage of concept mapping, students receive instruction on effectively communicating information in an organized and logical way [21]. At this stage, students summarize their reading results in a systematic concept map and then present it before cooperative learning is carried out. Making concept maps can help students organize material from general to specific [21]. Creating a concept map can also help students stay focused on the topic and sequence the flow of ideas to be written. This activity will train students' communication skills because one indicator of communication is the existence of a good information delivery organization [22], [23]. The activity of creating a concept map is carried out asynchronously and involves teamwork. In this way, it is hoped that there will be communication between team members so that they can produce a structured concept map. During the implementation of REMAP-RT, reading and concept mapping are conducted before engaging in classroom instruction, while in the classroom, the instructor will implement a cooperative learning model. The cooperative learning model employed in this study was reciprocal teaching (RT).

The subsequent phases within the REMAP-RT framework encompass generating questions, predicting answers, and clarifying information, constituting integral components of reciprocal-teaching cooperative learning. The cooperative execution of all stages of REMAP-RT learning occurs within group settings. In-class cooperative learning activities involve group discussions and group presentations, which can improve students' communication skills [24], [25]. This research was conducted to investigate the effect of REMAP-RT on student communication skills.

## 2. METHOD

### 2.1. Research design

The current study utilized the pretest-posttest control group experimental design to compare the difference in participants' communication skills after learning with three different models: REMAP-RT (Group A), RT (Group B), and discussion-presentation (Group C). The study was conducted for sixteen (16) meetings, where, in the first meeting, the participants were gathered to receive an explanation of the details of the learning processes. The first meeting also measured participants' oral and written communication skills. Then, each group was treated using different learning models from meeting 2 to meeting 15. In the last session (meeting 16), we collected the post-test scores from the participants' oral and written communication skills.

### 2.2. Research sample

In this study, purposive sampling was adopted to select three classes of students in the fourth semester of the Biology Education Study Program at State Islamic University, Tulungagung, Indonesia. A total of 89 students (between the ages of 19 and 21) enrolled in the microbiology class participated in the study. This research has received ethical approval from the university and the participants involved. All participants have completed the process of obtaining informed consent. Before sample selection, an analysis of variance (ANOVA) test was conducted in three classes to compare academic levels. The ANOVA analysis yielded a significance value of  $0.192 > 0.05$ , indicating no difference in the participants' grade point average (GPA). Cluster random sampling was used to select the experimental and control classes. The REMAP-RT class consisted of 33 students (experiment group), the RT class contained 29 students (positive control group), and the discussion-presentation class comprised 27 students (negative control group).

### 2.3. Intervention

The interventions administered to groups A, B, and C were REMAP-RT, RT, and presentations, respectively. The educational process in these three courses was conducted online, utilizing synchronous and asynchronous communication modes via two e-learning platforms. Asynchronous learning was facilitated using Google Classroom, whereas synchronous learning was facilitated using the Google Meet video conference platform. These two Google platforms were selected based on their accessibility across multiple devices, cost-free availability, and provision of diverse features aimed at facilitating student communication [26], [27].

The individuals assigned to group A engaged in REMAP-RT learning, which involved a series of learning stages: i) reading, ii) concept mapping, iii) generating questions, iv) predicting answers, and iii) clarifying information [19]. During the reading phase, each participant was instructed to locate and peruse scholarly literature that pertained to the subject matter being examined in the classroom setting. Subsequently, the participants were instructed to collaboratively construct a digital concept map in groups, representing a "bill" derived from their assigned reading material. Participants could utilize various digital mind mapping applications, such as X-mind, Simplemind, Mindmup, Creately, MindMeister, Mural, or Miro. During the subsequent phase, participants were instructed to generate inquiries derived from the content they had previously read. Every group member was required to submit a question, following which the group would collectively select two questions to be forwarded to other groups via the Google Classroom platform. Subsequently, each group formulated hypotheses regarding the anticipated responses to the inquiries they had acquired. The various stages of learning, specifically stages 1 through step 4, were conducted asynchronously. During the asynchronous learning sessions, student worksheets served as a means of regulating student engagement and participation. In the final phase of REMAP-RT, participants were instructed to engage in synchronous communication via Google Meet to provide further clarification on the questions they had previously posed.

The instructional approach employed in class B involved utilizing the RT learning model, which consisted of four stages: summarizing, generating questions, predicting answers, and clarifying information [28]. During the summarizing stage, the participants engaged in activities that closely resembled those conducted by students in class B during the reading stage. Individuals belonging to group B were not instructed to construct a concept map but rather to generate a summary of the outcomes derived from their reading endeavors. However, during questioning, predicting answers, and clarifying information, class B participants engaged in the same learning activities as class A participants.

Class C served as the control group in the study, wherein learning was facilitated using the discussion-presentation method. In this course, individuals were instructed to collaborate in groups to produce a research paper that aligns with the subject matter covered in the lectures. During the paper preparation process, all participants were tasked with locating relevant literature on the topic and engaging in

a collaborative effort to compile their papers. In addition, the papers were delivered in real-time via the Google Meet platform. The learning activities conducted in the three classes are presented in Table 1.

Table 1. REMAP-RT, RT, and discussion-presentation learning activities [19], [28]

Stages (mode)	Learning activities	REMAP-RT	RT	Discussion-presentation
Reading or writing a paper (asynchronous)	Every participant was instructed to conduct a literature search and engage with scholarly articles about microorganisms, including topics such as the characteristics and classification of microorganisms, the growth and reproduction of microorganisms, microbial metabolism, the significance of microbes in various life forms, and fundamental techniques employed in the study of microorganisms. This activity was done to establish a foundational understanding of the subject matter. Subsequently, participants were instructed to identify significant concepts derived from the literature they had perused and to utilize them as foundational material to write a summary or a paper.	✓	✓	✓
Concept mapping (asynchronous)	The participants were assigned to construct a concept map collaboratively based on their reading materials to synthesize and summarize the information they had gathered. Subsequently, the concept map was presented and shared on YouTube.	✓	-	-
Questioning (asynchronous)	Each group was instructed to formulate two questions generated from the literature they had perused. Then, the questions were reciprocally interchanged with questions from different groups.	✓	✓	-
Predicting (asynchronous)	The participants were instructed to make predictions regarding the answers to their questions and questions posed by other groups.	✓	✓	-
Clarifying (synchronous)	Within the group setting, participants engaged in the process of clarifying their answers through oral means, utilizing presentation and discussion activities. During this session, the participants also communicated their findings and assessments of their learning experiences.	✓	✓	✓

Remarks: ✓=executed learning stages and - =unexecuted learning stages

#### 2.4. Instrument

In this study, the communication skills measured included oral and written communication skills. Questionnaires are used to measure students' oral and written communication skills. Pre and post-test questionnaires were distributed at the beginning and end of the semester, respectively. Education and learning experts validated the test to determine its rational validity (content and construct validity). The development of this instrument involved three experts. They are invited to provide ratings and suggestions. The result is a content validity ratio (CVI) value of 0.96, meaning the instrument is valid. To determine the empirical validity and reliability of the test, it was first administered to students not included in the research sample. The r Pearson correlation calculations show a range of 0.237 to 0.475, classified as good to excellent [29]. Meanwhile, Cronbach's alpha value of 0.925 is high and can be used. The validity test demonstrated that the questionnaires were valid and reliable.

#### 2.5. Oral communication skills

Participants' oral communication skills were measured using a questionnaire that refers to the following indicators: i) information delivery organization, ii) language, iii) delivery, iv) material support, and v) main message. These indicators were adapted from Allen [22]. There are ten positive statement items in the questionnaire using the Likert-scale with a score of 1-4. The questionnaire blueprint used to measure participants' oral communication skills is shown in Table 2.

#### 2.6. Written communication skills

Participants' written communication skills were measured using a questionnaire referring to the indicators adapted from Florida Southwestern State College, including i) main idea and supporting details, ii) writing organization, iii) writing style, and iv) syntax [23]. The questionnaire contains five positive statements on a Likert-scale (1-4). Table 3 presents the blueprint of the questionnaire.

#### 2.7. Data analysis

The research data were analyzed using descriptive and inferential statistics. We analyzed the descriptive statistics' mean (M) and standard deviation (SD). Furthermore, we conducted an analysis of

covariance (ANCOVA) test for inferential statistics to identify learning efficiency in the experimental class and compared it to the other two control classes. The ANCOVA test was chosen as a data analysis technique because, in this study, the pretest was used as a covariate. Covariates are sufficient to remove confounding and provide biased estimates of the treatment effect in the presence of unmeasured confounding variables [30]. If the ANCOVA test yielded significant results, we continued data analysis using the least significant difference (LSD) to determine the class with the highest score and potential and the most significant difference compared to other classes [31]. The ANCOVA test began with testing the normality and homogeneity of the data using the one-sample Kolmogorov-Smirnov and Levene's equality of error variances. The results of the two tests showed that the data were homogeneous and normally distributed because of a significance value of more than 0.05 [32]. Complete normality and homogeneity test results are shown in Table 4.

Table 2. Blueprint of the oral communication skill questionnaire (modified from Allen [22])

Indicator	Statement(s)
Organization	I present the material from broad to specific topics in order. Before my presentation, I brief the audience on the subject matter I will cover. Throughout the presentation, I present information orderly, beginning with the introduction, proceeding to the body, and a conclusion.
Language	I use clear and simple language for the audience to comprehend when presenting the material.
Delivery	I use precise intonation, voice, and articulation when presenting the material. I appear confident and make eye contact with the audience when presenting the material.
Supporting material	I elucidate material with examples, analogies, pictures, and graphs. I use visual aids and multimedia to support my presentation. I use appropriate references to support the presentation.
Central message	I use repetition and emphasize the message's contents so that it can be conveyed clearly during the presentation.

Table 3. Blueprint of the written communication skill questionnaire (modified from Florida Southwestern State College [23])

Indicator	Statement(s)
Main Idea and supporting details	I make written assignments with clear main ideas supported by relevant and adequate references.
Organization	I create written assignments with clear main ideas and related explanatory sentences.
Style	I use standard language when writing assignments. I use clear and straightforward language when writing assignments.
Syntax	I use the correct grammar when writing assignments.

Table 4. The result of the normality and homogeneity test on oral and written communication skill data

Variable	Test	Kolmogorov-Smirnov <sup>a</sup>		Leven's test		Description
		Statistic	Sig.	Levene statistic	Sig.	
Oral communication	Pretest	0.090	0.069	2.865	0.190	Normal, homogenous
	Posttest	0.094	0.051	2.181	0.064	Normal, homogenous
Written communication	Pretest	0.093	0.056	2.867	0.615	Normal, homogenous
	Posttest	0.093	0.054	0.325	0.898	Normal, homogenous

### 3. RESULTS AND DISCUSSION

#### 3.1. Result

##### 3.1.1. Oral communication skills

The initial oral communication skills of participants in the three classes were not significantly different (Group A had the highest score, 48.32 (SD=2.27), followed by groups B and C with scores of 46.61 (SD=2.03) and 45.24 (SD=1.98), respectively. In contrast to the investigation's results, a minimal disparity was observed in the mean oral communication skills scores between groups A and B, precisely 96.35 (SD=2.29) and 90.05 (SD=2.40), respectively. Meanwhile, the mean score for group C was 81.30 (SD=2.17), indicating a comparatively lower performance than groups A and B. Table 5 summarizes the three groups' initial and final oral communication scores.

After that, we performed an ANCOVA test to confirm the presence of a significant difference between the three groups. The analysis findings presented in Table 6 demonstrate notable disparities in oral communication skills between students enrolled in the REMAP-RT class and students participating in RT lessons and discussions (control group) ( $F_{(1,88)}=87.818$ ;  $p=0.000$ ). Based on the effect size, it shows that the influence of the intervention on students' oral communication skills is also relatively high ( $\eta^2=0.508$ ).

Table 5. The results of the descriptive statistical analysis on participants' oral communication skills

Group	Test	Mean	Standard deviation
REMAP-RT (A)	Pretest	48.32	2.27
	Posttest	96.35	2.29
RT (B)	Pretest	46.61	2.03
	Posttest	90.05	2.40
Discussion-presentation (C)	Pretest	45.24	1.98
	Posttest	81.30	2.17

Table 6. The results of the ANCOVA test on participants' oral communication skills

Source	Type III sum of squares	df	Mean square	F	Sig.	Partial eta squared ( $\eta^2$ )
Corrected model	547.411 <sup>a</sup>	3	182.470	33.112	0.000	0.539
Intercept	116.889	1	116.889	21.211	0.000	0.200
Pretest_oral_communication	49.461	2	24.730	4.488	0.014	0.096
Model	483.938	1	483.938	87.818	0.000	0.508
Error	468.410	85	5.511			
Total	80876.000	89				
Corrected total	1015.820	88				

a. R Squared=.539 (Adjusted R squared=0.523)

To determine the most effective learning model for enhancing students' oral communication skills, we conducted an LSD test. According to the findings displayed in Table 7, the results obtained from the LSD analysis indicated a significant disparity in the oral communication skills of participants belonging to group A when compared to those in groups B and C. Based on our findings, participants belonging to group A (EM=93.35) exhibited superior oral communication skills compared to participants in group B (EM=86.05) and group C (EM=81.30). In conclusion, the REMAP-RT learning model improved students' oral communication skills more effectively than the RT or discussion-presentation models.

Table 7. The results of the LSD test on participants' oral communication skills

Model	Pretest	Posttest	Difference	EM Score	Notation*	Increase (%)
REMAP-RT	48.32	96.35	48.03	96.35	a	99.39
Reciprocal teaching	46.61	90.05	43.44	90.05	b	93.19
Discussion-presentation	45.24	81.30	36.06	81.30	c	79.70

Note: \* Different notation represents significant differences with other classes

### 3.1.2. Written communication skills

All participants in the three treatment classes had different written communication skills. Group A had a written communication skill score of  $M=52.25$  ( $SD=2.25$ ), followed by groups B and C with respective scores of  $49.62$  ( $SD=4.05$ ) and  $47.33$  ( $SD=3.93$ ). Likewise, the posttest scores showed that group A had the highest written communication skill score ( $M=91.25$ ;  $SD=4.84$ ), followed by group B ( $M=84.07$ ;  $SD=4.63$ ) and group C ( $M=70.20$ ;  $SD=4.48$ ). The results of the pretest and posttest of participants' written communication skills are summarized in Table 8.

Table 8. The results of the descriptive statistical analysis on participants' written communication skills

Group	Test	Mean	Standard deviation
REMAP-RT (A)	Pretest	52.25	2.25
	Posttest	91.25	4.84
RT (B)	Pretest	49.62	4.05
	Posttest	84.07	4.63
Discussion-presentation (C)	Pretest	47.33	3.93
	Posttest	70.20	4.48

In addition, the results of the ANCOVA test presented in Table 9 showed that the participants' written communication skills differed significantly after the learning process. The results showed significant differences in written communication skills between participants involved in REMAP-RT learning and participants who learned using RT and the discussion-presentation method ( $F_{(1,88)}=90.200$ ;  $p=0.000$ ). The partial eta squared calculation also shows that the effect of the intervention on students' written communication skills is relatively large ( $\eta^2=0.515$ ).

Table 9. The results of the ANCOVA test on participants' written communication skills

Source	Type III sum of squares	df	Mean square	F	Sig.	Partial eta squared ( $\eta^2$ )
Corrected model	441.475	3	147.158	33.434	0.000	0.541
Intercept	230.859	1	230.859	52.451	0.000	0.382
Pretest_written_communication	39.464	2	19.732	4.483	0.014	0.095
Model	397.007	1	397.007	90.200	0.000	0.515
Error	374.121	85	4.401			
Total	33,173.000	89				
Corrected Total	815.596	88				

a. R squared=0.541 (Adjusted R squared=0.525)

We administered the LSD test as a subsequent assessment to determine which group improved most significantly in written communication skills. According to the findings presented in Table 10, the results of the LSD analysis indicated a statistically significant difference in the written communication skills of participants belonging to group A compared to those in groups B and C. Based on our analysis, group A exhibited a more significant improvement in written communication skills compared to groups B and C. Therefore, REMAP-RT learning greatly impacted participants' written communication skills.

Table 10. The results of the LSD test on participants' written communication skills

Model	Pretest	Posttest	Difference	EM score	Notation*	Increase (%)
REMAP-RT	52.25	91.25	39.00	91.25	a	74.64
Reciprocal teaching	49.62	84.07	34.45	84.07	b	69.42
Discussion-presentation	47.33	70.20	22.87	70.20	c	48.32

Note: \* Different notation represents significant differences with other classes

### 3.2. Discussion

This study investigates the effect of the REMAP-RT learning model on students' oral and written communication skills. While earlier studies have explored the impact of REMAP-RT on 21st-century skills such as metacognitive and critical thinking skills, this research has not explicitly discussed its effect on communication skills, which are also included in the 21st-century skills domain. Data analysis revealed statistically significant differences in oral and written communication skills among participants enrolled in the REMAP-RT, RT, and discussion-presentation classes. The findings indicate that students enrolled in the REMAP-RT class have better oral and writing communication skills than students in the RT and discussion-presentation classes. The results of this study suggest that the REMAP-RT learning model, as proposed, exhibits a more pronounced impact on enhancing students' oral and written communication abilities compared to the RT and discussion-presentation learning approaches.

The improvement in students' oral and written communication skills, as observed in those who engaged in the REMAP-RT learning model, can be attributed to the systematic learning syntax employed. This syntax encompasses reading, concept mapping, generating questions, predicting answers, and seeking clarification. Every learning phase in the REMAP-RT model can enhance student engagement in learning and encourage communication between students. Reading activity in the first stage of REMAP-RT syntax correlates with communication skills [5]. Reading is an activity that enables students to comprehend learning materials [19] and increase their knowledge and understanding in tertiary institutions [5], [33]. Through this reading activity, students can convey information to others in simple language that logically flows from one topic to the next [5].

Concept mapping in the second phase of REMAP-RT syntax can help students organize information from broad to specific [19], [34], [35]. Concept mapping assists students in developing their written communication skills. Concept maps can foster cognitive, organizational, logical, and analytic thinking for dynamic writing and promote language mastery among university or college students [36]. Creating a concept map can help students remain focused on a topic and organize the flow of written ideas or concepts [37]. Presenting a concept map in front of the classroom will also aid in developing students' oral communication skills [38]. Concept maps help students create coherent presentation content (mutual support) [39].

Question formulation and answer prediction, the next stage of the REMAP-RT syntax, were conducted in groups. Participants then engaged in group discussions to determine the most critical questions to pose and to anticipate the answers. Peer discussions can enhance communication skills [24], [40] because communication is the process of exchanging information through interpersonal interaction [4]. Group-based learning activities can improve students' communication skills [19] more effectively than individual learning activities [41].

Clarifying information is the final stage of REMAP-RT, which can also promote college students' communication skills. Clarification activities are conducted through synchronous video conferencing presentations, specifically Google Meet. Video conferencing facilitates intimate engagement between students and lecturers as they can convene during scheduled learning periods [42]. Implementing synchronous cooperative learning can enhance student discussions and foster contact among students [43], [44]. In addition, individual or group presentation activities can enhance students' oral communication skills [45], [46]. This study showed that participants provided feedback on their peers' responses when providing clarification. If the responses were incorrect, students gave their arguments and opinions. Occasionally, students engaged in debate and argument when other groups' responses differed. Giving opinions, reasoning, and debating in the context of classical discussions also teaches college students practical oral communication skills [47].

The results of this study suggest that the complete REMAP-RT syntax plays a significant role in enhancing students' communication skills. The entirety of the learning process was conducted through online platforms to enhance students' oral and written communication skills. The utilization of online learning platforms has been found to benefit the development of student communication skills [48]. In online learning, students can flexibly share knowledge and communicate with their peers using discussion features and messenger applications [49]. Flexible online communication can reduce the gap between students and teachers as instructors and facilitate more effective peer-to-peer communication among students [50]. Furthermore, online learning has proven advantageous in enhancing student language proficiency, fostering intellectual curiosity, and cultivating student motivation [50].

Despite this study's intriguing findings, several limitations must be mentioned. First, we used convenience-based sampling, which could potentially bias the research results. All participants were registered from State Islamic University, Tulungagung, Indonesia. Thus, the sampling technique used can limit inference and generalize research results. The results of this study were also limited to three classes of sophomore students. Future studies may use a larger sample, considering various student demographic variables. Second, the findings of this study are also limited to microbiology lectures and communication skills variables so that in the future, the integration of the REMAP-RT model can be implemented in different subjects, education levels, and other 21st-century skills. Thirdly, the study instrument employed to assess communication skills is restricted solely to questionnaires. In the future, researchers may enhance the comprehensiveness of their research findings by including research instruments using oral communication observation sheets and written communication assessment rubrics.

#### 4. CONCLUSION

The findings of this study demonstrated that the implementation of the REMAP-RT learning model through online learning had a significant impact on improving college students' oral and written communication abilities. Students who were instructed to utilize the REMAP-RT method had better oral and writing communication skills than those taught using the RT and discussion-presentation approaches. Therefore, the REMAP-RT learning model is highly suggested to enhance oral and written communication skills, especially in online learning. Further investigation is necessary to gain more comprehensive results about the impact of offline REMAP-RT implementation on the same variables. Furthermore, the REMAP RT learning model offers the opportunity to do extensive research on a wide range of subjects, educational levels, and 21st-century skills.

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