ENHANCING COLLABORATION AND DIGITAL LITERACY THROUGH ONLINE READING-CONCEPT MAPPING-RECIPROCAL TEACHING

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ABSTRACT

Teamwork and collaboration are essential for students as they can help them learn how to work effectively with others, preparing them for future academic and professional success. Collaboration skills are helpful in both traditional and digital face-to-face learning environments. Successful implementation of online learning also requires a strong foundation in digital literacy. This study aims to investigate the online Reading-Concept Mapping-Reciprocal Teaching (REMAP-RT) learning model to improve collaboration and digital literacy in higher education. We used a nonequivalent pretest-posttest control group design involving 89 students from three Biology Education study program classes at a state Islamic university in East Java province of Indonesia. Each class was studied using one of three methods: a) REMAP-RT, b) RT, and c) PD. A questionnaire was used to assess students' collaboration and digital literacy skills. Analysis of covariance (ANCOVA) was used to compare differences in collaboration and digital literacy among the three treatment groups based on questionnaire responses. According to the statistical analysis, students in the REMAP-RT group performed better in collaboration and digital literacy than students from the RT and PD classes. The findings of this study pertain to suggestions for enhancing and optimizing learning models in higher education to foster collaboration and digital literacy.

Keywords: Collaboration, digital literacy, concept mapping, reciprocal teaching, online learning.

INTRODUCTION

Collaboration skills are seen as a means to achieve learning goals and outcomes for college students (Kuhn, 2015). Contemporary perspectives underscore the significance of collaboration skills as the ability to assume accountability for effectively engaging in cooperative endeavours with others (Fenwick & Kelly, 2023). Collaboration skills are one of the most critical competencies college students must possess to facilitate their ongoing learning (Nemiro, 2020). Collaboration is a crucial interpersonal element that enables college students to realize their potential as adult learners (Fenwick & Kelly, 2023). Recently, educational researchers have agreed to shift the focus from collaboration as a way of teaching courses towards the idea that collaboration is an educational outcome within the framework of 21st century skills (Liebech-Lien & Sjølie, 2021). Consequently, educators have faced increasing demands over the last ten years to restructure their instructional approaches to cultivate collaborative skills among college students in the classroom (Ritter et al., 2018).

One frequently mentioned issue in higher education is the deficiency in students' ability to collaborate effectively (Hidayati, 2019; Le et al., 2018). Collaboration in scientific classes occurs when there is a requirement to address difficulties in the course collectively (Haataja et al., 2021). However, Woolard (2018) emphasizes that arranging students to work in groups is challenging and rarely makes collaboration a teaching subject. There is a prevailing sense of apathy and indifference among students towards group assignments, leading them to opt for solitary work and split the tasks within the group (Donelan & Kear, 2023; Hidayati, 2019). The challenge at hand necessitates the implementation of a pedagogical strategy that can facilitate comprehension of the advantages associated with student participation (Woolard, 2018). One of the examples of pedagogical strategies is active learning.

Active learning can encourage students to be involved and contribute to group results (Eddy et al., 2015). Simultaneously, active learning can potentially address student indifference and neglect (Choi et al., 2021). One instance of active learning that can be implemented in the classroom is cooperative learning (Sholihah et al., 2023). Educators can employ cooperative learning as a pedagogical approach to foster productive student collaboration. This method integrates various components, including group processing, positive interdependence, and promotive interactions (Yang, 2023). Structuring student-promotive interactions has proven effective in optimizing classroom collaborative activities (Slavin, 2014).

Students' collaborative skills development has been extensively explored in traditional face-to-face educational settings. Still, its application and outcomes in online learning environments have received limited attention in scholarly literature. The prevalence of online learning has significantly increased in response to the global COVID-19 pandemic. The implementation of online cooperative learning can address the issue of students' deficient collaboration skills, facilitated by the ongoing advancements in digital technology (Carrillo & Assuncao Flores, 2022). The rapid development of cooperative learning, aided by digital technology, has garnered significant attention in academic circles (Abrams, 2019). Scholars have also acknowledged its high level of novelty and innovation (Crook, 2022).

Furthermore, educators have expressed a keen interest in exploring strategies to effectively incorporate collaborative skills into online learning (Choi et al., 2021). Online learning has numerous advantages, such as facilitating active learning experiences for students and providing a virtual platform for social engagement with peers (Choi et al., 2021; Mazzeo et al., 2025). The significance of communication and teamwork is underscored in such a setting (Ingols & Shapiro, 2013). Wegerif (2019) also argues that technology has an impact on changing how people think and interact with others. Increased connectivity needs to be responded to quickly by making joint decisions (Cappelli & Keller, 2014).

While the utilization of technology appears to offer a potential answer for addressing the issue of student collaboration skills, significant challenges occur within the realm of online cooperative learning. College students must develop digital literacy to facilitate effective online cooperative learning. Student digital literacy in Indonesia still needs improvement (Angraini et al., 2023; Bahri et al., 2022). College students with technological proficiency but who cannot effectively utilize technology for educational and academic advancement can have limited digital literacy (Tewari & Birla, 2018; Vuran et al., 2020). Thus, educators need to possess the knowledge and skills necessary to foster a positive climate when facilitating online learning, particularly when all students convene on a single virtual platform (Naykki et al., 2014). Bodemer et al. (2018) propose a strategy to address the challenge of online collaboration, which involves facilitating the exchange of information within a digital context among college students. The utilization of digital devices to promote knowledge exchange on certain subjects is expected to enhance the development of digital literacy among college students. In addition to this, it is worth noting that knowledge can also be collectively generated within group settings (Pifarre, 2019). Learning facilitated with digital technology like this is considered a strength for achieving digital literacy competency for college students (Otto et al., 2024).

The current study offered a cooperative learning approach, namely the Reading-Concept Mapping-Reciprocal Teaching (REMAP-RT), to promote online collaboration and digital literacy skills. REMAP-

RT emphasizes using reading, concept mapping, asking questions, predicting, and clarifying information to facilitate student learning through peer interaction (Zubaidah et al., 2020). In REMAP-RT, the reading process can be characterized as a strategy where this technique is deliberately provided to support scientific understanding (Cook & O'Brien, 2015). During the reading process, the classroom instructor allows students to conduct online searches for reading resources that pertain to the subject matter to be addressed during class. The instructor can also guide students while searching for reading material to help them locate valid and appropriate literature. For example, the instructor assists students in identifying relevant keywords related to the topic and choosing scholarly material from credible sources. This endeavour will enhance the digital literacy skills of individuals enrolled in higher education institutions. Despite students' pursuit of reading content, teachers mandate that they share it with their peer group. The objective is to teach them to collaborate. Students then summarize the results of their reading activity by creating a concept map (concept mapping).

Concept mapping enables college students to connect verbal and visual information to comprehend course material (Boerma et al., 2022). Concept mapping can be effectively employed in a collaborative setting when students utilize a digital tool to create a concept map. Incorporating digital technology with group learning strategies aims to familiarize students with collaborative practices and enhance their proficiency in digital literacy. College students need reading and concept-mapping activities to build initial knowledge before engaging in Reciprocal Teaching (RT) activities (Gilbert, 2018).

Reciprocal Teaching (RT) is a pedagogical approach that promises to enhance collaborative interactions among students within the classroom setting (Le et al., 2018). Limited empirical data support the idea that RT can enhance learners' cooperative skills. Hence, it is imperative to do additional research to explore the potential of RT cooperative learning to augment college students' collaboration skills. Apart from that, while RT is being carried out, educators try to train students to develop strong digital literacy skills. As an illustration, the instructor requests that students use appropriate sources when referencing another individual's written work, refrain from plagiarism, and utilize various communication tools such as Google Classroom, YouTube, Google Meet, and WhatsApp groups.

Although REMAP-RT has promising potential to enhance college students' digital literacy and collaboration skills, only a few controlled experimental studies have explicitly explored the effectiveness of REMAP-RT as a pedagogical method (Zubaidah et al., 2020). Moreover, the existing body of literature needs to comprehensively elucidate the use of technology in facilitating collaborative learning (Ramos et al., 2022). Technology is commonly perceived as a means of transmitting information rather than a tool for fostering students' knowledge acquisition and enhancing their collaborative skills. In other words, there needs to be more research on the effects of teamwork in online settings on collaboration skills and digital literacy. The present study aims to discover methods to reconstruct interactions between students in online settings (Kalmar et al., 2022).

The current study's findings will enhance the existing body of knowledge on REMAP-RT and contribute novel insights into how online cooperative learning can foster collaboration and cultivate digital literacy skills. This study addressed the primary research inquiry: "To what extent can REMAP-RT enhance the digital literacy and collaboration skills of college students?" To address this inquiry, we investigated the effects of REMAP-RT as technology-facilitated learning on students' collaboration and digital literacy skills. We compared the results of REMAP-RT classroom implementation with Reciprocal Teaching (RT) and presentation-discussion methods.

METHOD

The current study utilized a pretest-posttest control group experimental design (Creswell, 2012) to compare the difference in participants' collaboration and digital literacy skills after learning with three different approaches: REMAP-RT (Group A), reciprocal teaching or RT (Group B), and presentation-discussion or PD (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' collaboration and digital literacy skills. Then, each group was treated using different learning approaches from meeting 2 to meeting 15. In the last session (meeting 16), we collected the posttest scores from the participants' collaboration and digital literacy skills.

Participants

We sent permission letters to target universities before the research was conducted. After obtaining permission, relying on convenience sampling techniques, we involved college students from a state Islamic university in East Java province of Indonesia. A cohort of 89 students joined this research and signed informed consent to participate for one semester, equivalent to 16 classroom meetings. We also explained the research procedures and informed prospective students that the variables measured during the study would not affect their academic scores on campus. In addition, an equivalency test was administered utilizing participants' Grade Point Average (GPA) to ascertain the comparability of their initial collaboration and digital literacy abilities. After confirming negligible disparities in initial abilities (p-value > 0.05), the participants were allocated to three distinct classes: REMAP-RT, RT, and PD. The REMAP-RT class comprised 33 students, whereas the RT and PD classes comprised 29 and 27 students, respectively. A comprehensive breakdown of the research sample can be found in Table 1.

Table 1. Research Sample

Group	Gender		Total
	Female	Male	
REMAP-RT	28	5	33
RT	27	2	29
Presentation-Discussion	26	1	27
Total	81	8	89

Interventions

Three types of interventions were used in the three research classes: presentation-discussion learning, RT learning, and REMAP-RT learning. The REMAP-RT learning model comprises three primary stages, which are as follows: 1) reading and concept mapping, asking questions and predicting the answers, and clarifying information (Sholihah et al., 2016; Zubaidah et al., 2020). Table 2 displays the stages and modes involved in REMAP-RT learning.

Table 2. Learning Stages and Modes in REMAP-RT

Stage	Descriptions	Mode
Reading and Concept Mapping	Students collaborate in teams to do online research, specifically focusing on material about the morphological attributes of microorganisms and their categorizations (microbes, moulds, yeasts, fungi, and viruses). The reading materials should be compiled into a single Google Drive document and disseminated by a unified hyperlink.	Asynchronous via Google Classroom
	Students engage in the reciprocal exchange of reading materials, then peruse the acquired literature, and subsequently generate a digital, conceptual framework informed by the collective outcomes of their collaborative reading endeavours.	Asynchronous via WAG
	Students present their concept map and record their presentation using the Zoom recording feature, followed by the subsequent uploading of the recorded content onto the YouTube platform. The students disseminate the YouTube link to the class collective. Concurrently, other groups observe the video and then provide their reactions.	Asynchronous via WAG

Asking questions and predicting the answers	Each group is tasked with generating two questions. Students can ask, "What is the underlying mechanism governing the biosynthetic pathway reactions responsible for the formation of cell walls or peptidoglycan?" Apart from that, students in this stage also write temporary answers to the questions on student worksheets.	Asynchronous via WAG
	Students exchange questions with their peers in different groups and, after that, predict the answers. Students record their anticipated responses on the papers provided to students.	Asynchronous via WAG
	Students create presentation media encompassing a series of questions and corresponding answers from their own and other groups.	Asynchronous via WAG
Clarifying	Students present the questions and predicted answers to the questions.	Synchronous via Google Meet
	Students ask other groups to clarify the answers and write them on the student worksheet, for example, "The answer from group 1 is good and almost similar to ours. We want to add to number 1 that peptidoglycan synthesis starts from the gradual synthesis of N-acetylmuramic acid-pentapeptide UDP in the cytoplasm."	Synchronous via Google Meet

The second research class received RT learning. The learning steps received by the RT class were almost the same as the intervention received by the REMAP-RT class. However, there was no concept mapping activity. In the RT class, there were four learning steps, namely 1) summarizing, 2) making questions, 3) making answer predictions, and 4) clarifying (Gilbert, 2018). In the initial stage, students searched for literature related to the topic and then summarised the reading they obtained in narrative form. Furthermore, just like in the REMAP-RT class, students in the RT class also went through the activity of making questions, predicting answers, and clarifying answers. All activities in this RT class were carried out in groups and with the same online mode as the REMAP-RT class.

Meanwhile, for the control class, the intervention was presentation-discussion learning. Students were asked to form groups and search for literature related to the specified topic. Each group was assigned to create a paper based on the topic obtained. The paper that had been made was presented in front of the class, and continued with a question-and-answer activity. Students were asked to conclude the learning material at the end of the learning.

The educational process in these three courses was conducted online, utilizing synchronous and asynchronous communication modes via three e-learning platforms. Asynchronous learning was facilitated using WhatsApp Group (WAG) and Google Classroom, whereas synchronous learning was facilitated using the Google Meet video conference platform. WAG is used for communication and collaboration during asynchronous sessions, while Google Classroom is used for organizing and collecting assignments. The selection of WAG as an online platform was motivated by its capacity to facilitate real-time interaction and communication among students (Carr & Hayes, 2015; Lantaron, 2018). The seemingly limitless social interactions on social media are becoming increasingly important for online collaboration in the classroom (Lampropoulos et al., 2021). Google Classroom and Google Meet are user-friendly tools that facilitate seamless access and enable students to communicate effectively with their peers (Amadin et al., 2018; Dewi et al., 2022; Upadhyaya et al., 2025). Such settings can also bring together many students and offer opportunities to build high-level knowledge (Ngoc Hoi, 2023).

Instrument

This study employed a two-part questionnaire: the first part measured participants' collaboration skills, and the second part assessed participants' digital literacy. Each part utilized a 5-point Likert scale. The instrument items were back-translated from English to Indonesian and back-translated into English by a translator in the field of Education and a general translator. This was followed by a strict validation procedure conducted by three specialists in the field of science education. The three experts agreed that the content validity index (CVI) of the instrument was 0.98, which meets the standards set for a valid instrument. The questionnaire consisted of nine items to evaluate participants' collaboration skills. These items were developed by modifying the three dimensions of collaboration skills established by Allen (2014), namely contribution, responsibility, and respect for others' opinions. In addition, 25 items were used to assess participants' digital literacy. These items were adapted from the six characteristics of digital literacy proposed by Karpati (2011), namely accessing, organizing, evaluating, integrating, creating, and communicating. The empirical validation process also showed that the instrument had high validity and reliability indexes since the significance value was smaller than 0.01 ($p < 0.01$) and the correlation value (r) was close to 0.5. The instrument items demonstrated a strong correlation with one another (Aytar et al., 2015; Kocatepe et al., 2020) and were reliable because Cronbach's alpha showed a value bigger than 0.7 ($\alpha > 0.7$) (Taber, 2018). Table 3 summarizes the instrument's validity and reliability.

Table 3. The Instrument Used to Measure Participants' Collaboration and Digital Literacy Skills

Skills Assessed	Instrument's Validity and Reliability	Dimension (number of items)
Collaboration (self-report)	r= 0.438-0.861 α= 0.874	Contribution (3 items) Responsibility (3 items) Respect for other's opinions (3 items)
Collaboration (peer-assessment)	r= 0.467-0.816 α= 0.778	Contribution (3 items) Responsibility (3 items) Respect for other's opinions (3 items)
Digital literacy	r= 0.350-0.854** α= 0.935	Accessing (5 items) Organizing (3 items) Evaluating (4 items) Integrating (4 items) Creating (4 items) Communicating (5 items)

*Note. ** $p < 0.01$; r = correlation value; α= Cronbach's alpha*

Data Analysis

Data analysis was performed using descriptive and inferential statistics. First, we calculated the Mean (*M*) and Standard Deviation (*SD*) to determine the participants' collaboration and digital literacy skills before and after administering the interventions. Then, we compared the pretest and post-test results of the research classes using ANCOVA. We would carry out the Least Significant Difference (LSD) test if the ANCOVA showed a significance value smaller than 0.05 ($p < 0.05$). The LSD test was conducted to determine significant differences between the three interventions in influencing the variables. Before conducting the inferential analysis, we measured the normality and homogeneity of the pretest and post-test data using the one-sample Kolmogorov-Smirnov and Levene's Test for Equality of variance (Table 4). The normality and homogeneity of the data were confirmed if the significance value was more significant than 0.05 ($p > 0.05$) (Ghasemi & Zahediasl, 2012).

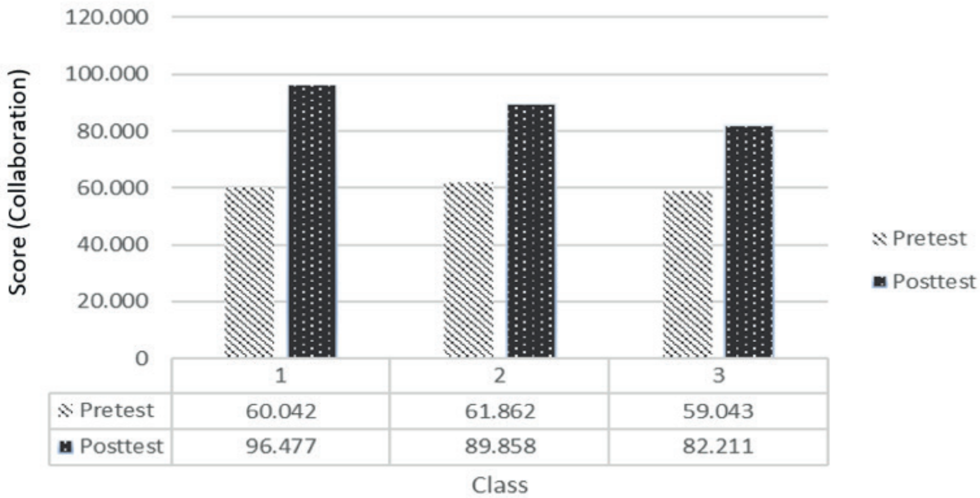
Table 4. Data Normality and Homogeneity

Dataset Test statistic		Kolmogorov-Smirnov test		Leven's test		Description
		Sig.	Levene statistic	Sig.		
Collaboration	Pretest scores	1.236	0.057	2.238	0.821	Normal, homogeneous
	Posttest scores	1.317	0.060	0.439	0.057	Normal, homogeneous
Digital literacy	Pretest scores	0.654	0.095	0.282	0.775	Normal, homogeneous
	Posttest scores	1.278	0.131	0.603	0.698	Normal, homogeneous

FINDINGS

Collaboration Skills in REMAP-RT

According to participants' pretest scores, the initial collaboration skills of students from REMAP-RT (*M*= 60.04; *SD*= 4.64), RT (*M*= 61.86; *SD*= 6.41), and presentation-discussion (PD) (*M*=59.04; *SD*= 5.89) groups were at the same level. Following the administration of research interventions in each class, the groups demonstrated diverse levels of improvement in collaboration skills. The highest post-test mean score was observed in the REMAP-RT group (*M*= 96.48; *SD*= 3.88), followed by the RT group (*M*= 89.86; *SD*= 4.71), and the PD group (*M*= 82.21; *SD*= 4.26). Thus, compared to other research groups, the REMAP-RT group demonstrated the highest increase in collaboration skills, which was 36.44 (60.68%). Meanwhile, the RT and PD groups showed a 27.99 (45.25%) and 23.17 (39.24%) increase in collaboration. The students' initial and final scores on collaboration skills are presented in Figure 1.



Note: 1 = REMAP-RT, 2 = RT, 3 = PD

Figure 1. Participants' Initial and Final Scores on Collaboration

Then, ANCOVA was done to measure the statistical difference in collaboration skills between the three research groups. The results of the ANCOVA (Table 5) showed that the three research groups differed significantly in collaboration ($F_{(1.88)}$= 80.707; p= 0.000). Meanwhile, the partial eta squared calculation indicated that the research interventions had a notable effect on participants' ability to collaborate (ηp^2 = 0.487).

Table 5. The Result of ANCOVA on Participants' Collaboration Skills

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared (ηp^2)
Corrected Model	476.079[a]	3	158.693	29.981	.000	.514
Intercept	3425.761	1	3425.761	647.201	.000	.884
Pretest_Collaboration	36.975	2	18.487	3.493	.035	.076
Res. Group	427.199	1	427.199	80.707	.000	.487
Error	449.921	85	5.293			
Total	81026.000	89				
Corrected Total	926.000	88				
a. R Squared = .514 (Adjusted R Squared = .497)						

The LSD test (Table 6) was performed to explain the difference in participants' collaboration skills. The covariate value used to determine the corrected mean was 60.880. The analysis result showed a significant difference between REMAP-RT (*Corr. M*= 96.46), RT, and PD groups regarding collaboration skills. In addition, the RT group (*Corr. M* = 89.85) differed significantly from the PD group (*Corr. M*= 82.20) in collaboration skills.

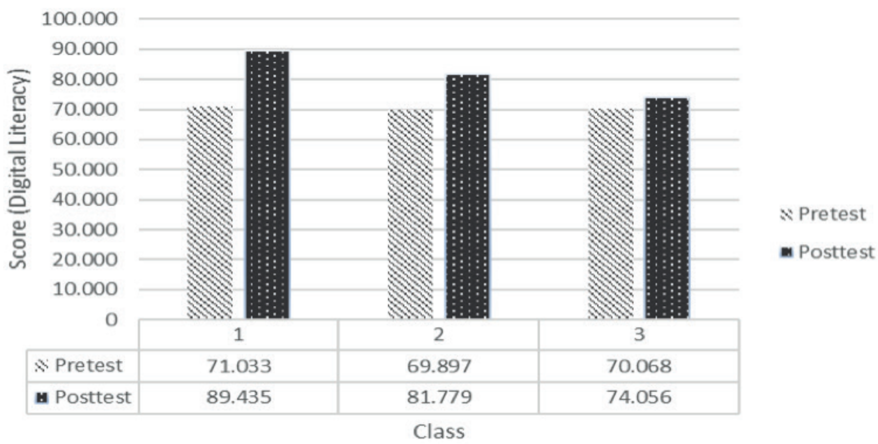
Table 6. The Result of the LSD Test on Participants' Collaboration Skills

Strategy	Corrected Error	Std. Error	95% Confidence Interval		Notation LSD
			Lower Bound	Upper Bound	
Presentation-discussion	82.200	1.034	78.018	85.869	a
RT	89.846	1.110	85.767	92.978	b
REMAP-RT	96.462	1.084	95.538	99.895	c

a covariates appearing in the model are evaluated at the following value: Collaboration Pretest = 60.880.

Digital Literacy in REMAP-RT

Students across the three research classes exhibited high similarity in digital literacy. The digital literacy score reported by the REMAP-RT group was higher than the others, which was 71.033 (*SD*= 10.14), followed by the presentation-discussion (PD) group, which was 70.068 (*SD*=11.82). Meanwhile, the RT group reported the lowest digital literacy score on the pretest, 69.897 (*SD*=11.05). Following the interventions, the post-test scores observed in the three research groups increased significantly, where the REMAP-RT group reported a mean post-test score of 89.435 (*SD*= 9.32), higher than that of the RT group (M= 81.779, *SD*= 8.38) or the PD group (M= 74.056, *SD*= 8.82). In other words, after receiving the intervention, the REMAP-RT group achieved the highest increase in digital literacy. We observed an 18.40 (25.90%) increase in the REMAP-RT group's post-test score and an 11.88 (16.99%) increase in the RT group's post-test score. The PD group, however, demonstrated the smallest increase in the post-test score, which was only 3.99 (5.69%). Figure 2 summarizes the participants' initial and final scores on digital literacy.



Note: 1 = REMAP-RT, 2 = RT, 3 = PD

Figure 2. Participants' Initial and Final Scores on Digital Literacy

According to the descriptive analysis, the digital literacy post-test scores obtained by the three research groups differed significantly. Then, ANCOVA was performed to confirm the finding, using the pretest scores as the covariate. The ANCOVA results (Table 7) showed that there was a significant difference in digital literacy between the three research groups ($F_{(1.88)}$= 102.475; p= 0.000). Based on its size effect, the research interventions had a considerable effect on participants' digital literacy (ηp^2 = 0.547).

Since ANCOVA demonstrated significance, the LSD test (Table 8) used a covariate value of 70.282. According to the LSD test results, the REMAP-RT group (*Corr. Mean* = 89.420) reported the highest corrected mean, significantly different from the mean scores obtained by the other two groups. The mean score achieved by the RT groups was 81.764, while the mean score obtained by the PD group was 74.045.

Table 7. The Result of ANCOVA on Participants' Digital Literacy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared (ηp^2)
Corrected Model	4629.928[a]	3	1543.309	38.443	.000	.576
Intercept	1131.098	1	1131.098	28.175	.000	.249
Pretest_Collaboration	296.963	2	148.482	3.699	.029	.080
Res. Group	4113.833	1	4113.833	102.475	.000	.547
Error	3412.320	85	40.145			
Total	584865.000	89				
Corrected Total	8042.247	88				
a. R Squared = .576 (Adjusted R Squared = .561)						

Table 8. The Result of the LSD Test on Participants' Digital Literacy

Strategy	Corrected Error	Std. Error	95% Confidence Interval		Notation LSD
			Lower Bound	Upper Bound	
Presentation-discussion	74.045	1.003	70.018	78.168	a
RT	81.764	1.026	77.550	84.344	b
REMAP-RT	89.420	1.045	85.510	93.647	c

a covariate appearing in the model are evaluated at the following value: Digital Literacy Pretest = 70.282.

DISCUSSIONS AND CONCLUSION

The current study examined the effectiveness of REMAP-RT conducted online in enhancing college students' collaboration and digital literacy skills. In this study, we discovered that participants' collaboration and digital literacy skills improved considerably after the interventions, with the REMAP-RT group exhibiting the highest increase in collaboration and digital literacy skills. We also found that collaboration skills contributed significantly to the digital literacy skills of participants from all classes. These findings align with previous research findings that REMAP-Cooperative learning could promote student collaboration (Indriwati et al., 2019). Scholarly investigations have also suggested that online collaboration could encourage students to actively learn from various online sources that could improve their digital literacy skills (Blau et al., 2020; Chan et al., 2017).

The Effect of REMAP-RT on Collaboration Skills

Following the research intervention, the REMAP-RT group demonstrated superior collaboration performance compared to the RT and presentation-discussion classes. There exist several plausible justifications. Initially, the REMAP-RT students possessed more opportunities for communication and collaboration through social media platforms. Students could engage in collaborative learning via a WhatsApp Group (WAG) by exchanging reading materials with their peers during reading activities. When creating a concept map, these students could cooperate via a concept map creator program or utilize WAG.

Additionally, they could connect using YouTube, as this platform allowed for the presentation and sharing of the concept maps that had been generated. Students could also collaborate in Google Classroom throughout the questioning phase. In addition, students communicated and collaborated via Google Meet to present their responses during clarifying exercises. Using diverse social media platforms for communication and collaboration has been identified as a viable strategy for enhancing individuals' communication and collaboration skills (Côte & Gaffney, 2021; Susanti et al., 2023). Prior research has also indicated that computer-assisted collaborative spaces, commonly called digital settings, offer several advantages, including developing social skills and promoting collaborative learning among students (Manca & Ranieri, 2017; Northey et al., 2018).

Furthermore, concept mapping, as depicted in Figure 3, facilitated collaborative engagement among students within group settings. Students possessed diverse knowledge acquired through their reading endeavors. Concept mapping can help students choose content for learning (Soto-Berelov et al., 2023). During concept mapping, students in the REMAP-RT class collaborated to complement each other's concepts to create a comprehensive concept map. Concept mapping activities can improve students' collaboration skills. When creating concept maps collaboratively, students will be trained to contribute to completing assignments by collecting information related to the topic and sharing information from reading results. Students are also trained to respect their group members' points of view through collaboration. Students are trained to be responsible for completing the task of creating concept maps and are trained to be able to participate in presenting the concept maps that have been created. Contributing and being responsible for completing group tasks and respecting other people's points of view are part of collaboration skills (Allen, 2014).

In addition, the preliminary information acquired by students through reading and concept mapping (REMAP) activities could serve as a foundation for posing open-ended questions intended to stimulate discourse within the primary REMAP-RT activities (Stokhof & Vries, 2020). Engaging students with diverse knowledge acquired from reading by posing thought-provoking questions is essential. This approach stimulates cognitive conflict within these students (Svanes & Andersson-Bakken, 2023). Question-making activities in REMAP-RT are limited to two questions per group. Students must accommodate all questions from their group members and then make a fair decision to choose two questions that will be asked as group questions. Next, the questions that have been prepared are exchanged with questions from other groups via Google Classroom. This activity will train students to respect other people's opinions and be responsible for submitting assignments on time. Respecting other people's opinions and submitting assignments on time is part of collaboration skills (Hadiwangsa et al., 2024; Hidayati, 2019). The foundational knowledge acquired by students through REMAP activities could serve as a framework for collaborative efforts in predicting solutions and offering clarifications. By possessing diverse information, students could enhance each other's responses through clarification.

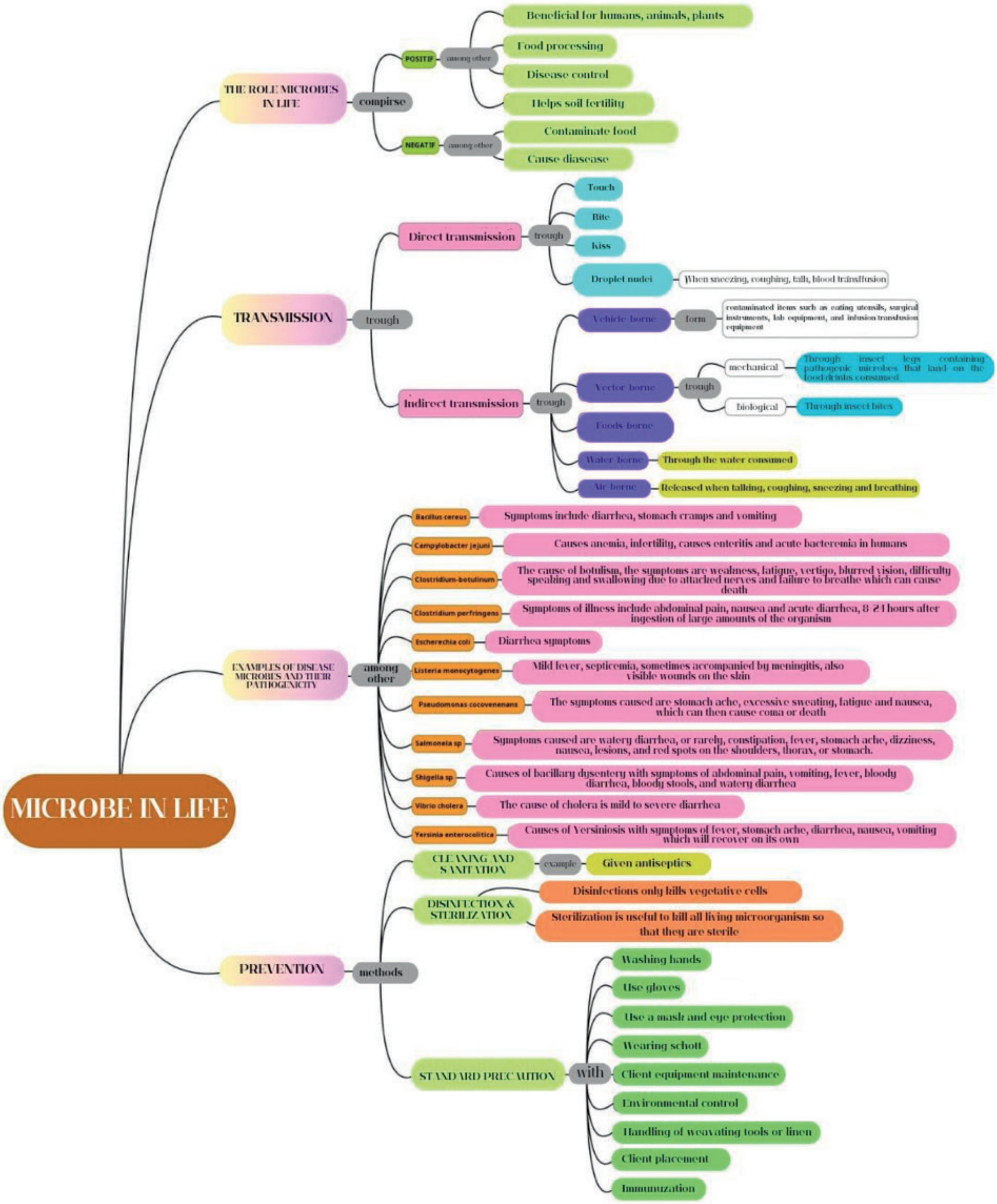


Figure 3. An Example of Students' Concept Mapping

The entire REMAP-RT syntax can support improving collaboration sk++++ills because it all contains elements of collaborative activities. When reading, students collaborate by exchanging literature. When making a concept map, students collaborate and share information to create a complete one. When creating questions, students collaborate, listen to the opinions of all members, and learn to make fair decisions in determining which questions will be used as group questions. When preparing answer predictions and clarifications, students discuss with each other, exchange information, and participate in classical presentations. All of these activities can empower students' collaboration skills.

The Effect of REMAP-RT on Digital Literacy

Besides collaboration skills, the REMAP-RT group also performed better in digital literacy than other classes. All learning activities in the online REMAP-RT class were designed to empower students to develop digital literacy. Online learning is distance learning that utilizes technological devices such as laptops, cell phones, and social media to facilitate learning. Using technological devices such as laptops, cell phones, and social media in learning activities can increase students' digital literacy (Cam & Kiyici, 2017). Students frequently use various technological devices, and their skills in operating and utilizing these digital devices will increase. Operating technological devices is a technical skill that is part of digital literacy. Techataweewan and Prasertsin (2018) define digital literacy as the ability to use information and communication technology, which requires cognitive and technical skills to find, evaluate, create, and communicate information.

Online-based REMAP-RT learning activities are also carried out using platforms such as Google Classroom, WhatsApp Group, Google Meet, YouTube, and various digital concept map-making applications such as Xmind, Mindmap, Mindmaster, etc. The various platforms and technologies used in the REMAP-RT learning process can significantly increase students' digital literacy and directly influence their daily work practices (Novo et al., 2016). Empowering digital literacy can be done by utilizing digital competencies and allowing students to access technology to solve complex problems (English, 2016).

The REMAP-RT learning design, which consists of reading activities, making concept maps, asking questions, preparing answer predictions, and clarifications carried out online, can empower digital literacy. Unique pedagogical designs that are prepared systematically and equipped with the application of technology can encourage the development of students' digital literacy competencies (Blau et al., 2020). The instructor should have provided the students with reading materials during the reading phase. Instead, they were tasked with sourcing their reading materials by independently locating and selecting relevant and reliable resources from the internet that align with the subject matter being studied. In the REMAP-RT class, the students were asked to share the materials with their peers within the study groups to enhance their ability to communicate knowledge through digital media. Searching for and finding appropriate and valid information on the internet and being able to share digital information is part of the essential competencies of digital literacy (Van Laar et al., 2020). According to UNESCO, essential digital literacy competencies include a person's ability to utilize information technology to access, manage, evaluate, integrate, create, and communicate information (Karpati, 2011).

Summarizing information from reading sources into a concept map and disseminating it through YouTube (as depicted in Figure 4) also helped the REMAP-RT students cultivate their digital literacy skills. Concept mapping in higher education equips undergraduate students with the necessary skills to proficiently employ digital technologies in creating academic outputs, such as concept maps. Using YouTube as a platform for presenting and sharing concept maps could facilitate the development of students' communication skills and their ability to provide constructive criticism through digital media. In summary, REMAP-RT offers students the chance to acquire skills in online communication and collaboration and proficiency in composing suitable and accurate online responses (Etgar et al., 2019) compared to RT learning and presentation discussion. The essence of digital literacy is operating computer software to search for, evaluate, utilize, create, communicate, manage information well, and behave online appropriately and wisely (Tang & Chaw, 2016). Summarizing activities in the form of digital concept maps can also help students bridge the gap between understanding printed texts and understanding digital texts, which in turn will improve learning in a digital environment (Ben-Yehudah & Eshet-Alkalai, 2018).

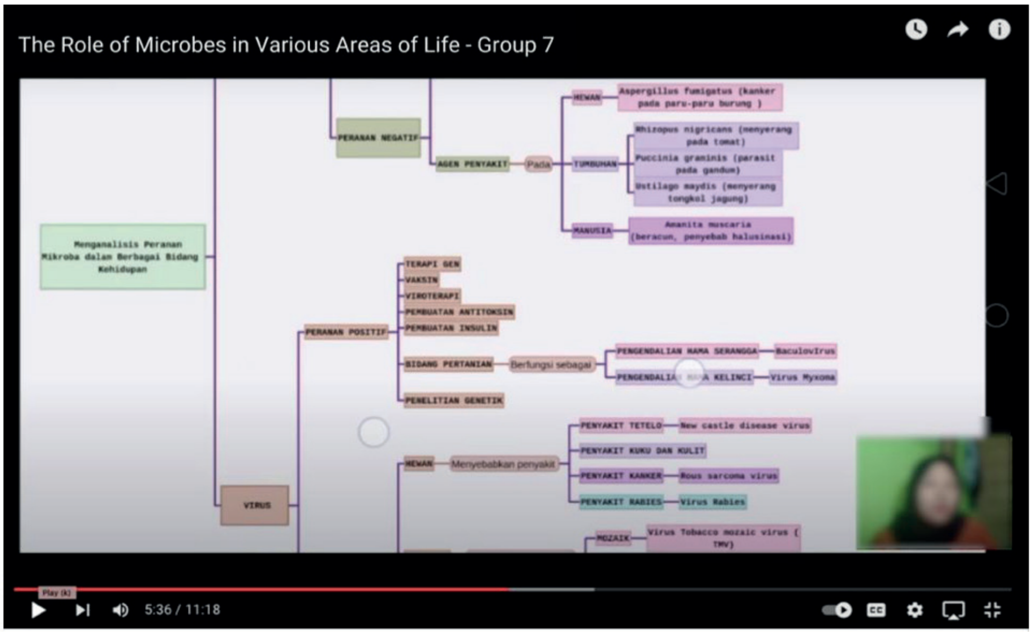


Figure 4. Concept Map Presentation Uploaded to YouTube

Making questions and predicting answers in REMAP-RT learning has provided many opportunities for students to discuss via social media, such as WhatsApp groups. The REMAP-RT class afforded the students increased access to social media platforms for information consumption, data sharing, collaborative problem-solving, and communication (Hershkovizt & Forkosh-baruch, 2017; Manca & Ranieri, 2017). This phenomenon is particularly evident in questioning, predicting, and clarifying activities. The results of the present study align with the conceptual framework proposed by Kasperski et al. (2022), which posits that digital literacy encompasses the capacity to comprehend and effectively utilize information in both synchronous and asynchronous interactions within a collective setting. Apart from that, when students create questions and prepare predicted answers, they share information from the results of previous reading activities so that group questions and predicted answers are prepared. Reading activities, understanding information, and combining heterogeneous information are skills in digital literacy (Eshet-Alkalai, 2012; Fraillon et al., 2014). The questions and predicted answers that have been made are then displayed in PowerPoint format, which will be collected on Google Classroom and presented via Google Meet. Collecting and transmitting information, communicating through presentations and images, and sharing documents online are at the heart of digital literacy (Vazquez-Cano et al., 2020).

REMAP-RT performs three critical components of an information system: the technology component, which involves the utilization of tools such as WAG and Zoom/Google meetings for both asynchronous and synchronous learning; the information component, which entails the exchange of information and the provision of answers and clarifications among participants; and the social component, which involves interaction between students during the learning process (Lee et al., 2015). These three information system components cause REMAP-RT to be able to shift the focus from the context of using technology only for communication outside of learning to using it in the classroom to achieve digital collaborative learning, which can increase students' digital literacy.

The findings of this study indicated that the implementation of REMAP-RT yielded more substantial enhancements in college students' digital literacy and collaboration skills compared to Reciprocal Teaching (RT) and presentation-discussion strategies. Online learning can be a valuable tool for enhancing students' academic abilities. Nevertheless, integrating RT and REMAP in online settings can significantly enhance the educational experience for college students. According to the findings, it is strongly advised that instructors incorporate REMAP-RT into their online learning classroom as a viable approach to enhance students' collaboration and digital literacy skills.

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