



## Fostering 21<sup>st</sup>-century skills: The effectiveness of Ricosre and digital flipbooks in enhancing student collaboration in biology learning

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### ABSTRACT

This study is expected to provide an overview of the utilization of the RICOSRE learning model assisted by the digital flipbook media to collaborative skills of 11th-grade students on the human excretory system topic. Collaborative skills are critical in biology because they enable students to work together, discuss, and get an in-depth understanding of the concept, thus promoting learners' efficiency and readiness for scientific problems. The study applied a quasi-experimental design to a non-equivalent pretest-posttest control group. The population comprised seven classes in 11th grade of the National Senior High School 6 Tasikmalaya science class. However, the sample was three classes, selected using purposive sampling, whereby XI Science 3 was the experimental class, XI Science 2 was a positive control class, and XI Science 5 was a negative control class. The Collaboration Self-Assessment Tool 44-item questionnaire was used to collect data and proved valid and reliable. The results of the ANCOVA test show that the learning model used in the experimental class achieved significant results compared to the model used in the control class. Moreover, the LSD test could measure the difference level; hence, workload RICOSRE with a digital flipbook was better than RICOSRE with PowerPoint and Discovery Learning with PowerPoint. The RICOSRE model supported by digital flipbooks significantly enhanced students' collaborative skills that help in keeping students active, interactive, and cooperative in learning biology. The findings recommended that teachers and curriculum developers apply this model to create engaging lessons that will keep students in continuing collaboration.

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## INTRODUCTION

The beginning of the 21st century was marked by rapid growth in science and technology (Mohamed Hashim et al., 2022), particularly in the field of information and communication technology (Timotheou et al., 2023). Thus, the competitive nature of life is increasing day by day. Furthermore, from an epistemological perspective, the use of ICT is changing the way humans access, validate, and generate knowledge, facilitating rapid, widespread, and decentralized digital learning (Mhlongo et al., 2023), while simultaneously requiring students to develop information and digital literacy, critical thinking, and problem-solving skills (Cai & Gut, 2020; Malahayati et al., 2025; Ramdani et al., 2024). In such a scenario, collaborative skills are a solution for individuals to be able to utilize ICT and apply their knowledge more efficiently (Sun et al., 2020).

Collaboration skills are a competency needed in 21st-century learning (Ramdani et al., 2022). In line with that, Hidayati, (2019) explains that collaboration skills can also foster and improve cooperation in groups to solve certain problems and increase their tolerance for differences of opinion among friends. Greenstein (2012) defines collaboration skills as the ability to work together in a learning process to unite differences, views, and knowledge through discussion by giving suggestions, listening, and supporting each other. Collaboration skills improve student learning outcomes (Ellis & Han, 2021). According to Thornhill-Miller et al. (2023), these skills are used in learning and are useful in all life contexts, so it is important to continue to develop them.

However, several research reports indicate that students' collaboration skills in science learning are low (Aufa et al., 2021) and need to be empowered (Ilma et al., 2022). Similar low student collaboration skills were found at National Senior High School 6 Tasikmalaya, Indonesia. Based on the results of interviews with class XI biology teachers at and the results of observations during the School Field Introduction activity, which was held from October 2 to October 27, 2023, the collaboration skills of students at National Senior High School 6 Tasikmalaya, Indonesia, are still low. This low collaboration skill can be seen during the learning process, where the learning is carried out in groups, but has not yet led to collaboration skills.

The results are shown by students who have difficulty conveying arguments and are less active and contribute less during discussions and presentations in class. According to Ofstedal & Dahlberg (2009), this learning certainly does not involve collaboration skills in the contribution indicator, where students cannot share ideas and information about the task. In addition, the lack of collaboration skills of students can also be seen from the lack of enthusiasm of students in group learning, because often some students, as group members, are irresponsible and do not do their tasks well, so that other group members feel tired and must do their assignments individually (Hikamah et al., 2025). This fact certainly does not follow the indicators of collaboration skills, according to Ofstedal & Dahlberg (2009), that is, there is motivation/participation of students to participate and stay involved, even when the discussion starts, not following personal interests.

One of the efforts that can be made to train students' collaboration skills in biology learning is to apply the RICOSRE learning model with the help of a digital media flipbook. RICOSRE stands for its syntax: reading, identifying the problem, constructing the solution, solving the problem, reviewing the problem solving, and extending the problem solving (Mahanal et al., 2022). This learning model follows the problem-solving learning model, which can be done in groups, where the learning stages are designed so that students are active in identifying problems, solving problems, and finding solutions to issues carried out in groups (Badriah et al., 2023).

The research conducted by Azrai et al., (2022); Putri et al., (2023); Setiawan et al., (2021) demonstrates that the utilization of RICOSRE has an effect on the learning process as well as abilities that are relevant in the 21st century. Nevertheless, according to the findings of Badriah et al., (2024) research report, the utilization of RICOSRE in conjunction with technology-based learning media results in a more significant impact than the utilization of RICOSRE alone, without any learning media.

One learning media that can be used in digital form is a flipbook. Digital Media flipbook is a digital book learning medium based on Flip PDF that contains animations, videos, and audio, so that it looks more attractive and not monotonous (Prasetyono & Hariyono, 2020). With this, it will be easier for students to understand the material, especially in biology, where phenomena or body structures that are difficult to see become more understandable (Azizah & Budijastuti, 2021). A good understanding of the material/concept will stimulate students' minds to be more active in discussions and express opinions (Dwi Wulandari et al., 2023). This opinion follows what has been stated by Nafiyanto &

Pebriana (2023), which states that mastering concept understanding will improve the quality of teamwork, increase collaboration, and achieve common goals.

In this study, the author uses the material of the human excretory system because the material is quite complicated, involving the relationship between several systems, such as the respiratory and sensory systems. This material is suitable for RICOSRE learning, which uses real-life problems and can be used to empower students' collaborative skills. The material on the excretory system is also included in the part of the biology lesson that is complicated to understand by students, as it covers a series of processes in the human body that involve organ structures that are difficult to explain without the support of tools or technology (Qumillaila et al., 2017). This research aims to determine the influence of the RICOSRE learning model assisted by flipbook digital media on students' collaboration skills on human excretion system materials. The combination of the RICOSRE model and flipbook media was chosen because no research has reported that the combination of the two can improve collaboration skills in biology learning.

## METHODS

### Research Design

The research method used was a quasi-experimental design with a non-equivalent pretest-posttest control group design. This method was chosen because the research was conducted in an existing classroom, making it impossible to randomize students. However, the quasi-experimental design still provided an objective way for researchers to measure the treatment effect between the experimental and control groups. This design was then used to assess changes in collaboration skills before and after the treatment, using pretests and posttests, thus allowing for differences in initial abilities between groups. For more details on the research method and design, see [Table 1](#).

**Table 1.**

Research Design

	Pre-test	Treatment	Post-test
Experiment	O1	X1	O2
Positive Control	O3	X2	O4
Negative Control	O5	X3	O6

Information:

- O1, O3, O5 = Pre-test
- O2, O4, O6 = Post-test
- X1 = RICOSRE's digital media flipbook-assisted learning model
- X2 = RICOSRE learning model with the help of PowerPoint media
- X3 = Discovery learning model powered by PowerPoint media

[Table 1](#) illustrates the non-equivalent pretest-posttest control group design with three groups: experimental, positive control, and negative control. Each group underwent a pretest and a posttest to assess changes in collaboration skills before and after the intervention. The experimental group employed the RICOSRE paradigm with a digital flipbook (X1), the positive control group utilized RICOSRE with PowerPoint (X2), and the negative control group implemented Discovery Learning with PowerPoint (X3). This design was employed to evaluate the efficacy of the three models in enhancing students' collaborative skills.

### Population and Samples

The population of this study consisted of eleventh-grade science students from National Senior High School 6 Tasikmalaya, Indonesia, comprising 7 classes with a total of 221 students. The sample of this study consisted of three classes, using a purposive sampling strategy based on the lowest uniform average score on the final semester exam. The sample used consisted of eleventh-grade science 3 as the experimental group (32 students), eleventh-grade science 2 as the positive control group (32 students), and eleventh-grade science 5 as the negative control group (32 students).

### Instrument

The instrument for this study was the Collaboration Self-Assessment Tool questionnaire (CSAT), developed by Ofstedal & Dahlberg (2009). This instrument was used to measure how effective the students are effective in their collaboration. The questionnaire consists of 44 statements representing key dimensions of collaborative skills. Content validity testing on the instrument was performed by

experts of making sure whether each of the statements was an appropriate indicator or dimension of the collaboration skill being measured. In addition, reliability testing on the instrument was also done to ensure the measurement results were consistent and stable.

### Procedure

This research was conducted over four sessions. The first session was a pretest for all classes. The second session focused on learning activities, where the experimental class and the positive control class, using the RICOSRE model, implemented the syntax of reading, identifying the problem, and constructing the solution. The difference between the two classes lay in the learning media used. Meanwhile, the class using the discovery learning model implemented the syntax of stimulation, problem statement, and data collection.

The third session was a continuation of the previous learning process. The RICOSRE class implemented the syntax of solving the problem, reviewing the problem solving, and extending the problem solving, while the discovery learning class continued with the syntax of data processing, verification, and generalization. The fourth session was the final stage of the research, administering a posttest to all classes after receiving treatment according to their respective learning models.

### Data Analysis Techniques

After the data from the study were obtained, a normality test was carried out using the Kolmogorov-Smirnov test, a homogeneity test using the Levene Statistic test, and a hypothesis test using the Analysis of Covariance Test (ANCOVA) with a follow-up test of Least Significant Difference (LSD). The results of this pre-test and post-test are also used to calculate the n-gain of collaboration skills to determine the improvement of each sub-indicator of collaboration skills.

## RESULTS AND DISCUSSION

The results of statistical data on collaboration skills in the experimental, positive, and negative control classes are presented in [Table 2](#).

**Table 2.**

Collaboration Skill Test Statistics

Data	Experimental Classes		Positive Control Class		Negative Control Class	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
N (valid)	38.00	38.00	38.00	38.00	40.00	40.00
N (missing)	0.00	0.00	0.00	0.00	0.00	0.00
Average	28.00	33.74	27.68	31.66	28.60	29.70
Median	29.50	33.50	27.50	31.00	28.50	29.50
Score Minimum	11.00	24.00	17.00	21.00	19.00	19.00
Maximum Score	37.00	42.00	37.00	43.00	39.00	43.00

In all three classes described in [Table 2](#), improvements in students' collaborative skills were clearly visible, but with different variations. In the experimental class, the average score increased from 28.00 to 33.74. This data proves that the experimental class was more effective overall. Meanwhile, the positive control class also showed a positive deviation, but its average was not as high as the experimental class: 27.68 before and 31.66 after. Finally, the negative control class's growth rate was minimal: the average before and after was 28.60 and 29.70. Thus, the learning model in the experimental class was overall more effective than the positive and negative control class models. Furthermore, the results of the normality and homogeneity prerequisite test of collaboration skill data are presented in [Table 3](#).

**Table 3.**

Prerequisite Test Results

Test Type	Experimental Group		Positive Control Group		Negative Control Group		Information
	Pre-test	Pos-test	Pre-test	Post-test	Pre-test	Post-test	
Normality	0.062	0.200	0.059	0.200	0.200	0.200	Normal
Homogeneity	0.768						Homogeneous

Table 3, presents the results of the prerequisite tests: the normality and homogeneity of variance tests of data on students' collaboration skills in the experimental class and two control classes. In the

normality test, it was found that the data in the pre-test and post-test had a significance value exceeding 0.05; thus, the p-value range was 0.059 to 0.200. Thus, this test indicates that the data in all three classes showed a normal distribution. Meanwhile, from the results of the homogeneity test, it was obtained that the data had a significance value greater than 0.05; thus, the pre-assumption of variance in the groups was homogeneous. Therefore, because the data met the assumptions of normality and homogeneity, it can be continued to the parametric statistical analysis stage ANCOVA to see whether the learning model is effective or not in improving students' collaboration. Furthermore, the hypothesis test results are presented in the following [Table 4](#).

**Table 4.**  
ANCOVA Test Results

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1605.794a	3	535.265	33.716	0.000	0.475
Intercept	760.121	1	760.121	47.879	0.000	0.299
Pre-test	1288.227	1	1288.227	81.144	0.000	0.420
Class	382.938	2	191.469	12.060	0.000	0.177
Error	1778.094	112	15.876			
Total	119685.000	116				
Corrected Total	3383.888	115				

a. R Squared = 0,475 (Adjusted R Squared = 0,460)

The relevant ANCOVA test results are presented in [Table 4](#). These examine the influence of the learning model on scores for students' collaboration skills after controlling pretest scores. The significance p-value (p) of the class variable from the analysis results is  $0.000 < 0.05$ . This means that after correcting for the influence of pretest scores, there is a significant difference between the posttest collaboration skills of the experimental class compared to both positive control classes and negative control classes. The ANCOVA indicates that the learning model adopted in the experimental class achieves significant results compared with that used by control classes. Next, a follow-up test with the Least Significant Difference (LSD) was carried out to find out if one group had a significant difference compared to the other group. In [Table 5](#), the results of the follow-up test with Least Significant Difference (LSD) are presented.

**Table 5.**  
Summary of Least Significant Difference (LSD) Test Results

(I) Class	(J) Class	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>	95% Confidence Interval for Difference <sup>b</sup>	
					Lower Bound	Upper Bound
Experiment	Positive Control	1.879*	0.914	0.042	0.067	3.691
	Negative Control	4.417*	0.904	0.000	2.627	6.207
Positive Control	Experiment	-1.879*	0.914	0.042	-3.691	-0.067
	Negative Control	2.538*	0.905	0.006	0.745	4.331
Negative Control	Experiment	-4.417*	0.904	0.000	-6.207	-2.627
	Positive Control	-2.538*	0.905	0.006	-4.331	-0.745

Based on estimated marginal means

\*. The mean difference is significant at the 0,05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

The results of the LSD test to determine the differences in average collaboration skill scores between each group after treatment are shown in [Table 5](#). As the analysis result, all interclass comparisons have a significance value of Sig. 1.879 and  $p = 0.042$ , which means that there is a significant difference between the experiment class and positive control class. On the other hand, there is 4.417 and  $p = 0.000$  for the experiment class and the negative control class, which proves the difference is much more than those. In the same line with the experiment and the positive control class, the positive control class with negative control has a difference score in the value of 2.538 and  $p = 0.006$ . As a difference, the treatment of learning led by the learning model of the experiment class has a higher influence on improving the students' collaboration skills as compared with the class of positive effect.

To make it easier to read the results of the Least Significant Difference (LSD) test from the ANCOVA collaboration skills test, the following [Table 6](#) presents the results of the Least Significant Difference (LSD) test from the ANCOVA collaboration skills test in the form of notation.

**Table 6.**  
Summary of LSD Test Results Notation

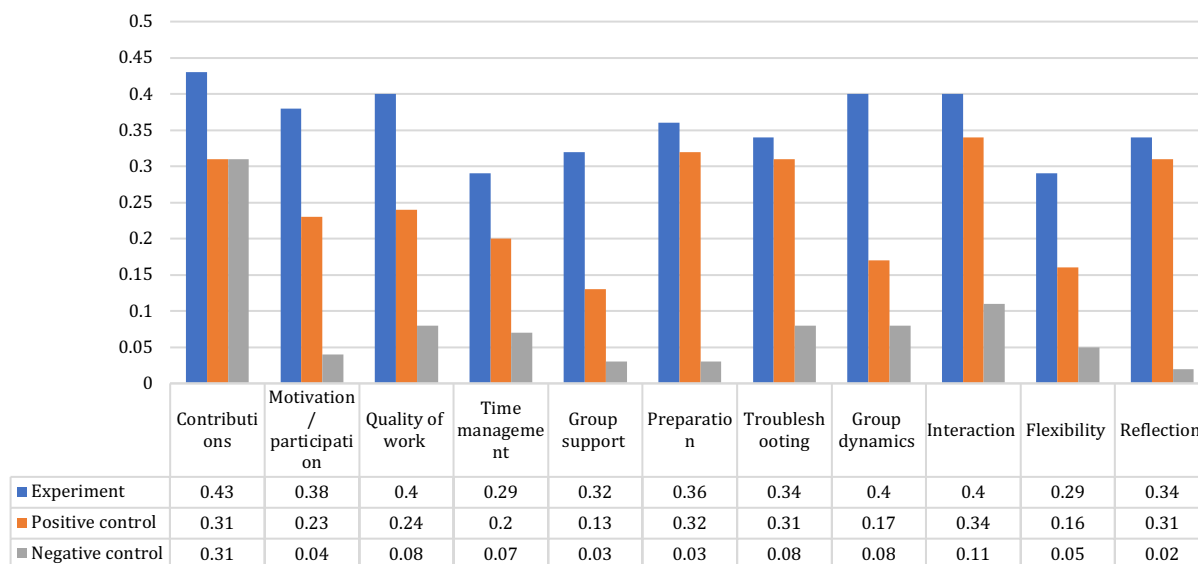
Learning	Pre-test		Post-test		Difference	Increased	Corrected Average	Notation
	M	SD	M	SD				
Experiment	28.00	5.63	33.74	5.03	5.74	20%	33.80	a
Positive Control	27.68	4.61	31.66	5.06	3.97	14%	31.92	b
Negative Control	28.60	5.67	29.70	5.50	1.10	4%	29.39	c

Based on [Table 6](#), learning in the experimental class by applying the RICOSRE model assisted by digital flipbook media empowered collaboration skills more than the positive control class applying the RICOSRE model assisted by PowerPoint media. Meanwhile, learning in the positive control class that applied the PowerPoint-media-assisted RICOSRE model empowered collaboration skills more than the negative control class that used the PowerPoint-media-assisted Discovery Learning model. This statement shows that the RICOSRE learning model assisted by flipbook digital media provides the best influence in empowering collaboration skills compared to the RICOSRE learning model assisted by PowerPoint media and the Discovery Learning model assisted by PowerPoint media.

RICOSRE's digital media-assisted learning model flipbook has a superior influence in empowering collaboration skills compared to the media-assisted RICOSRE learning model PowerPoint and discovery learning media-assisted PowerPoint because RICOSRE is a learning model that emphasizes the use of problems as a basis for achieving learning objectives, so that students actively solve problems in group discussions (Diani et al., [2023](#)). Problem-based learning will improve collaboration skills by involving students actively in learning activities and solving problems together (Hartina et al., [2022](#)). In addition, with the help of digital media, flipbooks facilitate students in improving their mastery of concept understanding (Ristanto et al., [2021](#)), thus stimulating their minds to be more active in discussions and expressing opinions (Dwi Wulandari et al., [2023](#)). This opinion follows what has been stated (Saysin & Dhammapissamai, [2023](#)), which states that mastering concept understanding will improve the quality of teamwork, increase collaboration, and achieve common goals. Meanwhile, the PowerPoint-assisted RICOSRE learning model scored lower than the digital media-assisted flipbook RICOSRE learning model, as the media used only presented material in bullet points, resulting in a lack of in-depth student understanding (Darwanto & Apriza, [2021](#)).

In addition, the learning model discovery learning PowerPoint-assisted learning model had lower scores than the digital media-assisted RICOSRE learning model flipbook and the media-assisted RICOSRE learning model PowerPoint. The result is that discovery learning is a learning model that requires students to discover a learning concept themselves (Anwar et al., [2023](#)). Although at the model stage, discovery learning involves collaboration, where students will share ideas and knowledge gained and then share with other members through discussion (Pambayun & Shofiyah, [2023](#)), the frequency of collaboration is not as large as the RICOSRE learning model, which is a learning model that focuses on problem solving (Sumiati et al., [2018](#)). The results were obtained using the learning model in the negative control class, which requires students to find a learning concept on their own, where, in the process, students are still hesitant to express their opinions on the information obtained. After all, the information obtained is the same as that of group members (Syafii, [2022](#)). In contrast to the RICOSRE learning model, which focuses on problem solving, it will make students find different information or ideas, so that there will be more opportunities for them to discuss.

The influence of each learning model can also be seen from the improvement of each sub-indicator of collaboration skills. Based on the results of the pretest-posttest scores of the experimental, positive, and negative control classes, the n-gain of collaboration skills can be calculated. The results of n-gain in each sub-indicator of collaboration skills can be seen in [Figure 1](#).



**Figure 1.** Comparison Bar Chart of N-Gain Comparison Per Sub-indicator of Collaboration Skills.

Figure 1 shows that the experimental class applying the RICOSRE learning model assisted by digital flipbook media had a greater improvement than the positive control class applying the RICOSRE learning model assisted by PowerPoint media and the negative control class applying the discovery learning model assisted by PowerPoint media. Based on the results of the pretest-posttest scores of the experimental, positive, and negative control classes, the following is an explanation of each sub-indicator of collaboration skills based on the acquisition of N-Gain.

Contributions to this indicator are activities for students to share ideas and information about the assigned tasks (Ofstedal & Dahlberg, 2009). In this indicator, the experimental class obtained an n-gain score of 0.43, the positive control class obtained an n-gain score of 0.31, and the negative control class obtained an n-gain score of 0.07 (Figure 1). When viewed from the three data points, the n-gain score of the experimental and positive control classes was in the medium category, while the negative control class was in the low category.

The high contribution indicators in the experimental class are due to the use of flipbook digital media, which can increase the mastery of concepts so that students can provide ideas or information they have obtained. With a good understanding of concepts, students will actively share their ideas by scientifically explaining physical phenomena and applying a fundamental and contextual concept to solve existing problems (Mariano-Dolesh et al., 2022). Meanwhile, in the positive control class, students read PowerPoint media while reading syntax. Delivering material using PowerPoint media in a practical form and points only will make the process of students' cognitive ability low due to the lack of in-depth understanding (Darwanto & Apriza, 2021). Meanwhile, in the negative control class, the learning model used requires them to find a learning concept themselves; because of this, students are still hesitant to express their opinions on the information obtained because the information received is the same as that of their group members (Syafii, 2022).

Motivation/participation in this indicator is an activity for students to participate in and stay involved, even when the discussion starts, not following personal interests (Ofstedal & Dahlberg, 2009). In this indicator, the experimental class obtained an n-gain score of 0.38, the positive control class obtained an n-gain score of 0.23, and the negative control class obtained an n-gain score of 0.04 (Figure 1). When viewed from the data of the three classes, the n-gain score of the experimental class was in the medium category, while the positive control class and the negative control were in the low category.

The learning media used by teachers can influence students' motivation (Puspitarini & Hanif, 2019; Safaruddin et al., 2020). From this, the experimental class's higher motivation/participation indicators are due to the use of flipbook digital media. This learning medium not only grabs students' attention but also helps them understand the concepts of the material to stay engaged in the discussion, even if the topics discussed are not directly relevant to their interests. Thus, the increase in scores on this motivation/participation indicator is related to the use of learning media, which differs from the control class, because they are used to PowerPoint media (Syafii, 2022). The elevated score of the

positive control group relative to the negative control group was mostly attributable to the implementation of the RICOSRE learning model, which differed from the conventional discovery learning approach.

The quality of work in this indicator is the quality of the tasks that have been done (Ofstedal & Dahlberg, 2009). In this indicator, the experimental class obtained an n-gain score of 0.40, the positive control obtained an n-gain of 0.24, and the negative control obtained an n-gain score of 0.08 (Figure 1). When viewed from the data of the three classes, the n-gain score of the experimental class was in the medium category, while the positive control class and the negative control were in the low category.

Qisthi et al., (2022), assert that poor job quality frequently results from inadequate communication, which is fundamentally linked to insufficient conceptual mastery (Safitri et al., 2022). Consequently, the elevated scores in the experimental class suggest that the utilization of digital flipbook media contributes to enhancing students' conceptual understanding, thereby positively influencing the quality of their work. The superior results in the experimental class relative to the control class, both positive and negative, are additionally affected by the adaptability of the flipbook media, enabling students to independently access and review learning materials using their cellphones..

Time management in this indicator is an activity to ensure that tasks are completed, and other tasks are adjusted to deadlines or responsibilities (Ofstedal & Dahlberg, 2009). In this indicator, the experimental class obtained an n-gain score of 0.29, the positive control class obtained an n-gain score of 0.20, and the negative control class obtained an n-gain score of 0.07 (Figure 1). If you look at the data of the three classes, the experimental, positive, and negative control classes are in the low category.

The low time management in the experimental class and the positive control class is because students are not used to learning, such as RICOSRE, which emphasizes problem solving, so that discussion activities take a long time because students sometimes have difficulty solving problems (Mahanal et al., 2022). Meanwhile, the low time management in the negative control class uses the discovery learning model, because one of the disadvantages of this learning model is that the discussion process takes a long time to help students find theories or other problem-solving methods. (Mukaramah et al., 2020).

Group support for this indicator is an activity on how students support the team, and their efforts are done (Ofstedal & Dahlberg, 2009). In this indicator, the experimental class obtained an n-gain score of 0.32, the positive control class obtained an n-gain score of 0.13, and the negative control class obtained an n-gain score of 0.03 (Figure 1). When viewed from the data of the three classes, the n-gain score of the experimental class was in the medium category, while the positive control class and the negative control were in the low category.

Group support is most effective when it exhibits emotional expression, positive and negative evaluation, honesty and non-judgment, identifying and assessing varying levels of uncertainty, information sharing, engagement in conversation, reasonableness, and positive reassessment (Setyawan & Syaifullah, 2023). Group support in the experimental class was higher due to using digital media flipbooks that increased students' understanding. With a deeper understanding, students become more active in interacting and engaging in learning activities (Kamaluddin et al., 2023). So, the interaction and involvement of these students can support the increase of group support.

Preparation for this indicator is an activity on how the readiness of students when they come to class, both the readiness of the tools and materials to be used, and the readiness to work in groups, is assessed (Ofstedal & Dahlberg, 2009). In this indicator, the experimental class obtained an n-gain score of 0.36, the positive control class obtained an n-gain score of 0.32, and the negative control class obtained an n-gain score of 0.09 (Figure 1). When viewed from the data of the three classes, the n-gain score of the experimental and positive control classes was in the medium category, while the negative control class was in the low category.

The high indicators of preparation in the experimental and positive control classes are due to the use of reading syntax that can build students' initial knowledge and connect it with new information to solve problems (Badriah et al., 2023). Equipped with a good understanding, students are more prepared to discuss and collaborate because they have a clearer picture of the material. Students in the experimental class have the flexibility to revisit source material through the use of their flipbooks. Therefore, in this class, students are better prepared to solve the problems presented

Problem-solving in this indicator is how students actively seek solutions to problems (Ofstedal & Dahlberg, 2009). In this indicator, the experimental class obtained an n-gain score of 0.34, the positive

control class obtained an n-gain score of 0.31, and the negative control class obtained an n-gain score of 0.08 (Figure 1). When viewed from the three data points, the n-gain score of the experimental and positive control classes was in the medium category, while the negative control class was in the low category.

The results were obtained because RICOSRE itself is a learning model based on problem solving, so it makes students more active, especially in listening, speaking, giving ideas or arguments orally, being able to solve problems, and being able to strengthen the understanding gained during learning (Yuliskurniawati et al., 2019). Meanwhile, discovery learning used in negative control classes is a learning model that requires students to discover a learning concept on their own (Anwar et al., 2023). In the experimental class, students' problem-solving indicators were higher than in the positive control class. This is because the use of flipbooks allows students to set their learning pace and explore the material according to their needs, which are essential skills for supporting problem-solving.

Group dynamics in this indicator are activities on how students support the group and respond to the needs of others (Ofstedal & Dahlberg, 2009). In this indicator, the experimental class obtained an n-gain score of 0.40, the positive control class obtained an n-gain score of 0.17, and the negative control class obtained an n-gain score of 0.08 (Figure 1). When viewed from the data of the three classes, the n-gain score of the experimental class was in the medium category, while the positive control and negative control were in the low category.

According to Yoel et al., (2022), Effective communication related to productivity, high levels of engagement, and clarity of purpose play a key role in successful group dynamics. Judging from the learning implementation process carried out in the experimental class, with the help of the flipbook digital media used, it results in a good understanding of concepts in students, so that students can communicate and engage effectively related to productivity in the form of relevant rebuttals and rebuttals accompanied by existing evidence (Antonio & Prudente, 2021). Equipped with a good understanding of concepts, the RICOSRE model used in this class also provides students with the opportunity to be more active, especially in listening, speaking, giving ideas or arguments orally, solving problems, and strengthening the understanding gained during learning (Yuliskurniawati et al., 2019).

The utilization of flipbooks that were developed expressly to promote RICOSRE learning was the reason for the high scores that were achieved in the experimental class. Not only did these flipbooks function as a method of distributing content, but they also served as a learning flow guide that expressly governed each phase of the group work process. Because of this benefit, students were able to keep order in the process of working in groups and reduce the number of disagreements that occurred over tasks or subsequent stages.

Interaction in this indicator is an activity on how students listen, respect, appreciate, and support the efforts of others (Ofstedal & Dahlberg, 2009). In this indicator, the experimental class obtained an n-gain score of 0.40, the positive control class obtained an n-gain score of 0.34, and the negative control class obtained an n-gain score of 0.11 (Figure 1). When viewed from the three data points, the n-gain score of the experimental and positive control classes was in the medium category, while the negative control class was in the low category.

The teaching process is a series of communication activities between students, teachers, and other students (Pouriye et al., 2022). Interaction when working together in a learning process can provide experiences and new things, where they are allowed to speak, express opinions, and make decision-making in learning (Ekaputra, 2023). The high score in the experimental class is due to the use of flipbook digital media, which can increase the mastery of concepts, so that students can provide ideas or information they obtain (Dwi Wulandari et al., 2023). Furthermore, in the experimental class, flipbooks were designed so that each group member could actively observe each other's progress on assignments. This advantage resulted in the experimental class achieving greater interaction than the other classes.

Meanwhile, in the positive control class, students read from package books or PowerPoint media during the reading session. Delivering material using PowerPoint media in a practical form and points only will make the process of students' cognitive ability low due to the lack of in-depth understanding (Darwanto & Apriza, 2021). Meanwhile, in the negative control class, the learning model used requires them to find a learning concept themselves; because of this, students are still hesitant to express their opinions on the information obtained, because the information received is the same as that of their group members (Syafii, 2022).

Flexibility in this indicator is the ability of students to move between the roles of leaders and followers (Ofstedal & Dahlberg, 2009). In this indicator, the experimental class obtained an n-gain score of 0.29, the positive control class obtained an n-gain score of 0.16, and the negative control class obtained an n-gain score of 0.05 (Figure 1). When viewed from the data of the three classes, both the experimental class, the positive control, and the negative control are in the low category. The low flexibility is due to some students having a better material absorption ability to understand the material. Still, the knowledge they have is only for themselves, and it isn't easy to share their knowledge with others (Ekaputra, 2023). This phenomenon makes it difficult for students in all classes to flexibly switch roles during the learning process, from leader to follower, and vice versa.

Reflection on this indicator is the ability of students to reflect on themselves to improve collaborative activities (Ofstedal & Dahlberg, 2009). In this indicator, the experimental class obtained an n-gain score of 0.34, the positive control class obtained an n-gain score of 0.31, and the negative control class obtained an n-gain score of 0.02 (Figure 1). When viewed from the three data points, the n-gain score of the experimental and positive control classes was in the medium category, while the negative control class was in the low category.

The nearly identical scores obtained in the experimental and positive control classes using the RICOSRE model were found in the Reviewing the Problem-Solving syntax. Through the Reviewing the Problem-Solving syntax, students are given the opportunity to openly evaluate and reflect on their group's problem-solving process (Mahanal et al., 2022). This fact indicates that for evaluation indicators, the use of different media in RICOSRE learning tends not to have a significant impact. In contrast to the negative control class, students who are accustomed to the discovery learning model assisted by PowerPoint media tend to ignore the reflection process and only focus on completing assignments quickly.

## CONCLUSION

The RICOSRE learning model, enhanced by flipbook digital media, significantly enhances students' collaborative skills in comparison to the RICOSRE learning model supplemented by PowerPoint media and Discovery Learning supported by PowerPoint media. The RICOSRE learning approach, enhanced with digital flipbook media, significantly improves the collaborative skills of eleventh-grade students at National Senior High School 6 Tasikmalaya, Indonesia, regarding the human excretory system throughout the 2023/2024 academic year. This study offers biology education utilizing advanced, creative, and novel learning technologies for educators. This concept also allows those who build curricula to create biology-based teaching that is cooperative.

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