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The Effectiveness of Character-Based Comic Media on Environmental Conservation Sub-Material Learning Outcomes

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Abstract: The utilization of learning media is one of the alternatives to increase knowledge for students, especially biology learning. In addition, student character can be improved through media in which there is character insertion. Thus, an innovative learning media is needed to improve knowledge and character through character-based comics on environmental conservation submaterial. This research method is a quantitative experiment, with a pretest-posttest control group research design. The sample consisted of 28 control class students and 30 experimental class students. The instruments were 20 multiple choice questions and 22 character questionnaire statements. Data analysis techniques include knowledge assessment measured using the Independent samples t-test formula. The results of data analysis showed that the knowledge of experimental class students increased significantly, the learning outcomes in the experimental class showed a higher average of 86.67 while the control class was 74.46, the average difference in learning outcomes between experimental and control classes was evidenced by the independent samples t-test test value of 0.00 <0.05, and student character showed a percentage of 81.44% in the excellent category. It is concluded that character-based comic media on environmental conservation submaterial can help improve cognitive learning outcomes and student character.

Keywords: Character based comics; Environmental conservation; Learning outcomes

Introduction

Seeing the current low level of character, character education is very important so that Human Resources have good character. The Ministry of National Education has designed a character education curriculum for students so that students have moral responsibility and have superior character (Salahudin & Irwanto, 2013). Character education is implemented at all levels of education starting from Early Childhood Education, Elementary School, Middle School, High School to tertiary level and in every subject, one of which is biology learning because it is closely related to living things and the surrounding natural environment. It is necessary to instill character in students to always maintain and preserve the surrounding natural environment (Rohmanurmeta & Dewi, 2019).

Character education implemented in the school environment will have a direct impact on learning outcomes, as stated by Supliyadi et al. (2017) students who have good character values tend to have good learning outcomes too. The observation findings show that the biology learning process of environmental conservation submaterial applied in class X IPA MAN 1 Kubu Raya still uses conventional learning methods (lectures) assisted by *PowerPoint* media (PPT) which are felt to be less effective in arousing students enthusiasm for learning, so that low activity is shown by students who do not pay attention to the teachers explanation and PPT slides displayed in front of the class, attention to the teacher is only given by students who sit in front while students who sit in the back usually pay less attention, and some students still do not understand when a discussion or question and answer is held due to lack of focus so that it has an impact on student learning outcomes which are still below the KKM which is 75 with an average score of 74. 29.

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Based on the results of observations, the learning process is centered on the teacher and the media used by the teacher is *PowerPoint* does not yet contain character education values, so it cannot encourage students to develop character in accordance with the Ministry of Education and Cultures regulations regarding Strengthening Character Education. Thus, it is necessary to instill character values in learning activities. Conveying character through learning media can be a solution for forming student character. The teacher's ability to design or compile learning media is very important in determining the success of the learning process (Hardiansyah & Mulyadi, 2022). Media preparation can be designed by teachers or teachers with students (Rahmawati & Rukiyati, 2018).

Based on these problems, it is necessary to instill character values in learning activities. Choosing learning media that supports student activity will have an impact on student learning and the use of different learning media can create a new, innovative and creative classroom atmosphere (Rahayuningsih & Setiawan, 2023). The use of newly used learning media, students can have new experiences and have a high curiosity (Alika & Radia, 2021). So, in this research, character-based comic media was used in the environmental conservation sub-material, adopted from media developed by Sari (2021) from the Biology Education Study Program, Tanjungpura University to improve students cognitive and character learning outcomes. This media contains 5 character values including religious values, nationalist sub-values namely discipline, integrity sub-values namely caring for the environment, mutual cooperation sub-values namely cooperation, and independence sub-values namely curiosity.

According to Negrete (2013) which states that comics are a good medium for communicating information in the learning process. Character-based comics are effective in improving students character, such as the character of discipline and responsibility, where the discipline character of students is increased with a gain *score of* 0.62 in the medium category and the character of student responsibility is increased with a gain *score of* 0.66 in the medium category (Saputro & Soeharto, 2015). Research by Puspitorini et al. (2014) shows that characters show improvement for the better after using character-based comic media. Through characterization in comics, the values of the characters contained can be conveyed to students. The research conducted by Nugraha et al. (2013) aims to insert character values in character-based comic media so that students can understand the positive messages contained in them and can implement them in everyday life. He also stated that the development of character values such as caring for the environment, curiosity, social care, discipline and creativity can be developed through character-based comic media. The character-based comic media in the environmental conservation sub-material used in this research is expected to be an innovation in teaching and learning activities to improve students cognitive and character learning outcomes.

Method

This research is a Quasi Experimental Design research with a Pretest-Posttest Control Group Design. In this design there are two classes consisting of an experimental class and a control class. The experimental class was taught using character-based comic environmental conservation while the control class was taught using *PowerPoint* media. The target of this study were class X students at MAN 1 Kubu Raya for the 2022/2023 academic year. Determination sample use technique sample fed up. According to Sugiyono (2022) sample fed up is technique determination sample if all member population used as sample. After second class given the next pretest determination class control And experiment done with method drawn obtained class X IPA-1 as class control class X IPA-2 as class experiment.

The instrument in this study consisted of pretest and posttest questions totaling 20 multiple choice questions, as well as a questionnaire containing the five main characters of Strengthening Character Education with a total of 22 statements consisting of religious values, discipline, curiosity, care for the environment, and cooperation. The learning tools used are the learning implementation plan and student worksheet.

This research activity begins with the preparation stage, namely conducting interviews with biology teachers, making learning tools and instruments, validating and testing learning tools and instruments, analyzing trial results, determining a research schedule.

The second stage related to implementation is giving pretest before determining the sample, determine the research sample, conducting learning activities with treatment, and conducting posttests in control and experimental classes and giving character questionnaires in experimental classes. The third stage related to reporting is analyzing and processing learning outcome data and character questionnaire data, describing the results of data processing while concluding the results, and compiling reports.

Analysis of cognitive learning outcomes data was carried out by normality tests using the *Shapiro Wilk test* and homogeneity tests using the *Bartlett-test*. After that, the hypothesis was tested using a *t-test* using the *independent samples t-test*. In this test, IBM SPSS version 26 *software* was used. The magnitude of the influence of

learning using character-based comic media on student learning outcomes in the environmental conservation sub-material was calculated using the *effect size formula.* For the character questionnaire data, after it was distributed to the experimental class, the score for each student's answer was calculated. Scores for positive and negative statements are presented in Table 1.

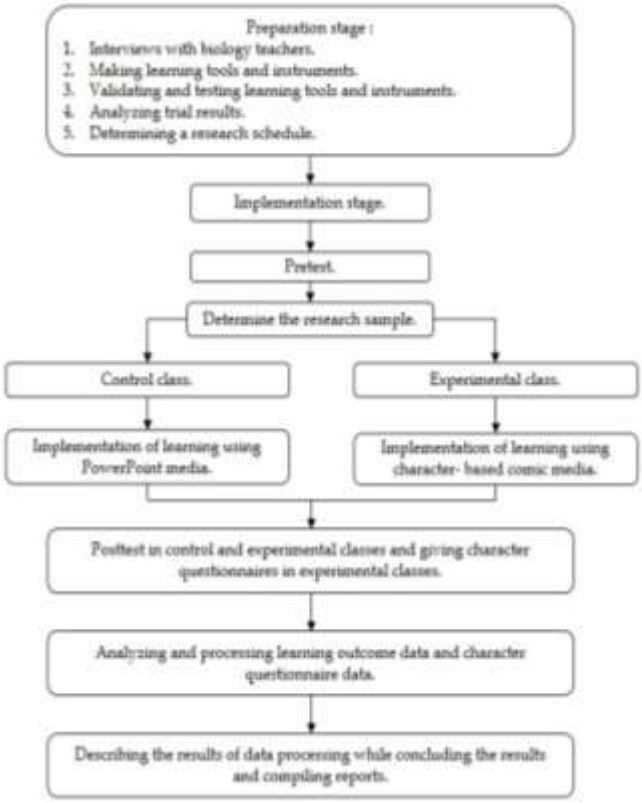

Figure 1. Research flow

Table 1. Likert Scale Score

Likert scale instrument	Positive statement score (+)	Negative statement score (-)
Often	3	1
Sometimes	2	2
Never	1	3

After calculating the score, calculate the percentage of character questionnaire data by using Formula 1 and Formula 2:

$$\% = \frac{Jumlah\ skor\ total\ jawaban\ responden}{Skor\ maksimal\ ideal}\ x\ 100\% \quad (1)$$

formula = maximum score x number of statement items x number of respondents (2)

Then interpreted in the criteria presented in Table 2.

Table 2. Range of Interval Scores

Interval class	Criteria
81-100	Very good
61-80	Good
41-60	Enough
21-40	Not enough
0-20	Very less

Results and Discussion

Outcomes in terms of the pretest and posttest *results* of the experimental and control classes can be seen in Table 3.

Table 3. Average Student Pretest and Posttest Results

Data	Pretest experiment	Pretest control	Posttest experiment	Posttest control
Average	68.33	71.60	86.67	74.46
Standard deviation	13.28	9.62	8.93	10.48
Completeness	40%	53.57%	93.33%	60.71%

Based on the research results shown in Table 3, it is known that the average learning outcomes of the experimental class using character-based comic media were higher than those of the control class using *PowerPoint*. There is a difference in the learning outcomes of the experimental class and the control class due to the different treatment given to the two classes. This is known from the average pretest score of students in the environmental preservation sub-material, namely 68.33, which then experienced an increase in the posttest score, namely 86.67. This is because character-based comic media has an attractive appearance, a coherent storyline, there are examples found in everyday life, and contains environmental conservation material so that teachers can utilize this media in the teaching and learning process because it is educational. This is in accordance with what was stated by Ramdhani et al. (2020) that comics are simple, clear and easy to understand so that they become informative and educative media.

In addition, Farahiba (2022) also revealed that using this learning media can make it easier for students to quickly understand the contents of comics because it uses everyday language and stories that students experience everyday and is equipped with simple pictures that can clarify the words or narrative of comic stories, and attractive colors make students to continue reading and learning, so this learning media is suitable for use to obtain better learning outcomes. According to Fitrianingsih et al. (2019) also said that by using color and relating the material to everyday life, students will better understand the material provided and the learning process in class will be enjoyable. Student

learning outcomes in the experimental class and control class can also be known based on the percentage of completeness of student learning outcomes by learning objective which can be seen in Table 4.

Based on Table 4, the first learning objective is for students to be able to explain the meaning of waste correctly, with question numbers 17, 18, 19, and 20. The percentage of completeness of learning outcomes by learning objective in the experimental class is 93% higher than the control class at 79%. The percentage of the experimental class is higher than the control class because the control class only displays points for the types of waste, does not display the meaning and there are no pictures. Meanwhile, in the experimental class, material about the meaning of waste, the meaning of organic waste, inorganic waste, and examples are presented in character-based comic media accompanied by colorful pictures, so that they can be seen more clearly and make it easier for students to understand. Learning media that are suitable for todays students are learning media that have characterized or animated images (Mujtahid et al., 2023).

Table 4. Percentage of Completion of Student Learning Outcomes by Learning Objective

Learning objectives	Question number	Average percentage of correct answers by question		Average percentage of correct answers by learning objective	
		Control	Experiment	Control	Experiment
Students are able to explain the meaning of waste correctly.	20	46.42%	86.67%	79%	93%
	19	100%	93.33%		
	18	82.14%	96.67%		
	17	85.71%	93.33%		
Students are able to classify waste based on its constituent components correctly.	16	85.71%	83.33%	81.42%	92.67%
	15	92.85%	93.33%		
	14	89.28%	96.67%		
	13	60.71%	90%		
	12	78.57%	100%		
Students are able to analyze data on waste types based on their constituent components correctly.	11	67.85%	80%	75%	83.34%
	10	82.14%	86.67%		
Students are able to correctly identify the causes and impacts of waste in schools.	9	75%	80%	75.89%	90.84%
	8	82.14%	96.67%		
	7	75%	90%		
	6	71.42%	96.67%		
Students are able to analyze appropriate ways to overcome environmental problems as an effort to preserve the environment.	5	82.14%	56.67%	82.14%	56.67%
Students are able to determine how to process waste using environmentally friendly methods appropriately.	4	78.57%	90%	58.03%	78.34%
	3	57.14%	76.67%		
	2	60.71%	90%		
	1	35.71%	56.67%		

This is in line with Ramdhani et al. (2020) that the visual aspect of media is very supportive in learning because learning uses more of the sense of sight, so media emphasizes the visual side with the aim of making students enthusiastic about learning and the material is more easily remembered in students memories. According to Badeo et al. (2018) the use of comics in learning is much better than textbooks because the content of comics contains material presented through certain images. Interesting pictures in comics make it easier for students to understand the material so that it has an impact on learning outcomes (Khaira et al., 2020).

The second learning objective is for students to be able to classify waste based on its constituent components correctly, with numbers 12, 13, 14, 15, and 16. The percentage of completeness of learning outcomes by learning objective in the experimental class is 92.67% higher than in the control class amounting to 81.42%. The percentage of the experimental class is higher than the control class, because in the experimental class the presentation of the material is complete in character-based comic media, and students can re-open the character-based comic media when working on student worksheet outside of class to classify waste based on its components and help students to understand again. This media motivates students to learn more independently (Hariyani et al., 2021). Purwanto et al. (2020) state that media that can be used repeatedly, helping students to re-understand the parts they have not understood.

Figure 2. Definition of waste

Figure 3. Waste classification

Meanwhile, students in the control class only presented points and when working on student worksheet outside of class, students only relied on material that had been presented by the teacher using *Powerpoint*. Thus, the use of character-based comic media can make it easier for students to study anywhere. This is supported by Utariyanti et al. (2015) that the benefits of comics in printed form are so that students can easily use them at any time without the help of electronic devices.

The third learning objective is for students to be able to analyze data on waste types based on their constituent components correctly, with question numbers 10 and 11. The percentage of complete learning outcomes by learning objective in the experimental class is 83.34% higher than the control class at 75 %. The high percentage of the experimental class is because the character-based comic media contains an explanation of the problem of waste that has not been managed properly, for example being thrown into water bodies and burned causing pollution, accompanied by a presentation of waste data in Kubu Raya Regency. Meanwhile, in the material presentation control class there was no presentation of waste data.

The material topics in this media are based on things found around everyday life, related to the real world, and presented in everyday language (Maulidah & Wulandari, 2021). Thus, students can understand it more easily. According to Nengsi (2019) the material is presented in the form of stories in comics and there are also some non-standard sentences which will be attractive to students and easier to understand. The choice of storyline in comic media is made to carry themes that often occur in everyday life so that students understand it more easily (Novisilta, 2016). Through the phenomena around them, students are trained to develop their knowledge (Brandstetter et al., 2017).

The fourth learning objective is for students to be able to identify the causes and impacts of waste at school correctly, using the question number 6, 7, 8, and 9. The percentage of complete learning outcomes by learning objective in the experimental class was 90.84 % higher than the control class at 75.89%. The higher percentage of the experimental class than the control class is because the presentation of material in the control class is presented in the form of descriptive sentences, while in the experimental class the character-based comic media contains explanations accompanied by pictures of environmental conditions that have not been polluted as well as pictures of waste problems that have not been managed properly, for example being thrown into water bodies and burned causing the environment to be polluted. Comics media describe the reality of everyday life (Safarati & Zuhra, 2023). So, that students are

indirectly trained to connect visual messages with experiences in their daily lives (Wijaya et al., 2020).

The fifth learning objective is for students to be able to analyze the appropriate way to overcome environmental problems as an effort to preserve the environment, with question number 5. The percentage by learning objective in the control class is 82.14% higher than the experimental class at 56.67%. The material in question number 5 is actually already available in character-based comic media about waste problems in part II. However, because question number 5 is a hots question type (C4 or analyze) some students in the experimental class had difficulty answering. In line with Rahayu et al. (2021) that if students are not trained to answer analytical questions, then students tend to find it difficult to answer and develop their thinking abilities.

The sixth learning objective is for students to be able to determine how to process waste using environmentally friendly methods correctly, with questions number 1, 2, 3, and 4. The percentage of completeness of learning outcomes by learning objective in the experimental class is 78.34% higher than in the control class amounting to 58.03%. The higher percentage of the experimental class than the control class is because the waste processing material contains an explanation of the stages of waste recycling such as making compost and recycling paper as well as a discussion of efforts to reduce waste in everyday life by implementing 6R (*reuse, reduce, replace, recycle, repair,* and *refill*) are completely presented accompanied by pictures in character-based comic media making it easy for students to understand and remember. This is supported by Utariyanti et al. (2015) having illustrations in the form of pictures in comics can help students interpret and remember lesson material. Media that makes students happy in learning so that it is easier to understand the material then the media is declared effective in learning (Kartika et al., 2023). Meanwhile, in *PowerPoint* media, although it also presents the application of 6R, it does not explain the recycling stages, it only mentions waste recycling products.

To determine student's initial abilities before receiving the treatment process in learning between the experimental and control classes, a normality test and homogeneity test were first carried out on the students pretest data. The pretest data normality test was carried out using the *Shapiro Wilk test*, in class X IPA-1 a significance value of 0.06 was obtained and in class thus, the pretest data for both classes has a significance value > 0.05, so the pretest data for both classes is normally distributed. Based on the results of homogeneity testing with the *Bartlett-test*, sig was 0.09. Thus, the pretest data for the two classes has a significance value > 0.05, so the pretest data for both classes comes from a population that has homogeneous (same) variance, so it is continued with the *t-test*. Based on the results of the *t-test* using the *Independent samples t-test,* a sig (2- *tailed*) value of 0.29 was obtained. Thus, the pretest data for the two classes has a significance value of > 0.05, which means there is no difference in the pretest *results*, so that classes X IPA-1 and X IPA-2 have the same initial abilities.

To see knowledge after following the learning process by giving treatment to the experimental class using character-based comic media, while the control class used *PowerPoint*, a normality test and homogeneity test were first carried out on the student's posttest data on the environmental conservation sub-material. The posttest data normality test was carried out using the *Shapiro Wilk test*, the control class obtained a significance value of 0.12 and the experimental class obtained a significance value of 0.10. Thus, the posttest data for both classes has a significance value > 0.05, so the posttest data for both classes is normally distributed.

Based on the results of homogeneity testing with the *Bartlett-test,* sig was 0.40. Thus, the posttest data for both classes has a significance value of > 0.05, so the posttest data for both classes comes from a population that has homogeneous (same) variance, so proceed with the *t-test*. Based on the results of the *t-test* using the *Independent samples t-test,* a sig (2- *tailed*) value of 0.00 was obtained, it can be concluded that there are differences in learning outcomes between students taught using character-based comic media (experimental class) and students taught using *PowerPoint* media (control class). In line with research by Krishnan et al. (2016) shows that students who are involved in learning using comics can be motivated thereby increasing students knowledge.

Meanwhile, research by Aisyah et al. (2023) shows that there is a significant difference between pretest and posttest scores after using educational *digital* comic media regarding the human blood circular system with a sig (2-tailed) *t-test* result of 0.00. Similar research conducted by Utaminingsih, Susanti, Fajrie, & Khamdun (2023) obtained a *t-test* result of 0.00 with a significance level of 0.05 so it was concluded that there was a difference between the pretest and posttest scores after using science interactive comic media.

Effect size calculation obtained an ES value ≥ 0.8 of 1.2 is included in the high category. If converted into a normal curve table from the OZ table, the area obtained is 0.3849. This shows that learning using character-based comic media has an influence of 38.49% on the learning outcomes of class X students in environmental conservation sub-material at MAN 1 Kubu Raya. In line with Widyawati et al. (2019) research the use of character-based science comic media has a significant influence on improving learning outcomes regarding addictive substances and psychotropic substances.

Research conducted by Yani et al. (2023) shows that comic learning media provides good effectiveness as evidenced by the N-Gain value of 0.52, which is included in the medium category. Then, the results of the percentage of student characters consisting of five characters can be seen in Table 5.

Based on Table 5, the average overall character score was 81.44% in the very good category. There are 3 characters that are classified as very good consisting of religious character at 90%, discipline character at 83.89%, and cooperative character at 89.72%. Meanwhile, the 2 characters that are classified as good are the character of curiosity at 72.22% and caring for the environment at 71.39%. In line with research by Puspitorini, Prodjosantoso, Subali, & Jumadi (2014) that learning outcomes in the affective (attitude) and character domains show improvement for the better after using character-based comic media.

Table 5. Results of Student Character Percentages

Character	Number of items	∑total respondent's answer	Ideal maximum score	Percentage of achievement	Annotation
Religious	7	567	630	90%	Very good
Discipline	4	302	360	83.89%	Very good
Curiosity	3	195	270	72.22%	Good
Environmental care	4	257	360	71.39%	Good
Cooperation	4	323	360	89.72%	Very good
			Average	81.44%	Very good

The cultivation of character education in this research was achieved through invitations and examples of good character modeling inserted in character-based comics, including religious, disciplined, curious, environmentally conscious and cooperative characters. However, when compared with 3 characters such as religiousness, discipline, and cooperation which get percentages above 70%, the characters of curiosity and caring for the environment only get percentages of 72.22% and 71.39% even though they are classified in the good category. This can happen because the activities of the three characters are used to being involved or carried out in the learning process.

Figure 4. Religious character

In line with Angga et al. (2022) statement that character can be formed if activities are carried out routinely and repeatedly so that they become a habit and over time it does not just become a habit but becomes a character, for example respecting teachers and older people and starting and ending Learning by praying is an application of religious character in every biology and other learning. The insertion of religious characters in character-based comic media is respecting teachers by kissing their hands as a form of respect for teachers and elders.

Then the character of discipline is also used to being applied when students enter school on time and are ready to receive learning and collect student worksheet according to the specified time. The insertion of a disciplined character in character-based comic media is that the character Ranti orders Dika not to be late with the sentence "You are undisciplined! Next time, don't be late, poor Joko who has been waiting.

Figure 5. Character of discipline

The character of cooperation is also seen from student group members who work together in working on student worksheet. Thus, because they are accustomed to being involved or carried out in the learning process, these characters have been embedded in students, so the percentage of these three characters is high. Meanwhile, for the character of curiosity, the teacher during the learning process instructs students if they want to ask questions related to the material of the first and second meetings and at the stage of analyzing and evaluating, the teacher again invites students to ask about material that has not been understood in order to foster students curiosity and dare to ask. However, it was seen that not all students asked, namely 5 to 6 people who asked every meeting. This can happen because each student has a different curiosity, there are times when students have questions but are afraid to express their questions.

This is supported by Jannah et al. (2021) that cultivating the character of curiosity in schools around us is not an easy thing to instill in students, because everyone's curiosity tends to be different. This applies to students who have low curiosity. There are also many students who basically have a high level of curiosity, but are embarrassed to express it because they think they might be the only ones who don't know the unanswered questions for themselves. Apart from this, students dare to ask questions other than because they really don't know what is being asked, there are also students who ask to confirm the answers they get as a form of confidence in the validity of their answers.

For the character of caring for the environment, the activities in student worksheet, namely sorting waste and making processed products from waste, are one application of environmental care, however , these activities are not used to being carried out by students. This can be seen from the fact that the waste processing process in schools is not well managed, where the final step in dealing with waste is by burning it. As stated by Bahrudin (2017) until now the level of concern for the environment is only owned by a handful of individuals. Permatasari et al. (2022) also stated that until now people have not found awareness regarding parts of the environment, in fact people consider the environment to be something separate from themselves so that much of the environment is damaged. Therefore, the percentage of the characters of curiosity and environmental care is not as high as the characters of religion, discipline and cooperation. In essence, teachers have emphasized each character during the learning process because A teacher is not only a teacher, but also a motivator, facilitator, and innovator (Fatimah & Fatonah, 2023). However, the learning process only takes place in two meetings, while the cultivation of this character requires a long time (Zuliana, 2022) in order to form habits that are done repeatedly so that they become characters in students (Angga et al., 2022).

Conclusion

The learning process using character-based comic media environmental conservation can improve and have an influence of 38.49% on affective learning outcomes in the form of student character and student cognitive learning outcomes. This can be seen from the percentage of student character of 81.44% with a very good category and learning outcomes in the experimental class showed a higher average of 86.67 while the control class was 74.46. The difference in the average learning outcomes between the experimental and control classes is evidenced by the independent samples t-test value of 0.00 <0.05.

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Writing—original draft preparation, L.I.; review and editing, K.N. and A.Y. All authors have read and agreed to the published version of the manuscript.

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