

THE EFFECT OF USING RECYCLED MATERIAL LEARNING MEDIA ON JUNIOR HIGH SCHOOL STUDENTS' MATHEMATICS LEARNING MOTIVATION

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Article Info

Article history:

Received July 15 , 2026

Revised July 21 , 2026

Accepted July 30 , 2026

Keywords:

Learning Media, Recycled Materials, Learning Motivation

ABSTRACT

This study aimed to examine the effect of using recycled material-based learning media on junior high school students' motivation to learn mathematics, particularly in the topic of three-dimensional geometry. Mathematics is often considered a difficult subject because many of its concepts are abstract, resulting in low student motivation during the learning process. Therefore, the use of concrete and innovative learning media is expected to improve students' motivation and engagement. This research employed a quantitative approach using a pre-experimental method with a one-group pretest-posttest design. The population and sample consisted of 16 ninth-grade students at SMP Babul Istiqamah Susoh, selected using a saturated sampling technique because the entire population was involved in the study. Data were collected using a non-test instrument in the form of a learning motivation questionnaire administered before (pretest) and after (posttest) the implementation of recycled material-based learning media. The questionnaire consisted of 16 Likert-scale statements measuring students' learning motivation. Data were analyzed using descriptive statistical analysis, normality testing with the Shapiro-Wilk test, and hypothesis testing through the Paired Sample T-test using SPSS version 27. The results revealed that the average learning motivation score increased from 37.38 in the pretest to 58.94 in the posttest. Before the treatment, most students were categorized as having low learning motivation (75%), whereas after the treatment, the majority were categorized as having high (62.50%) and very high (12.50%) learning motivation. Furthermore, the Paired Samples T-test produced a significance value of $< .001$ (Sig. < 0.05), indicating that the null hypothesis (H_0) was rejected and the alternative hypothesis (H_1) was accepted. These findings demonstrate that recycled material-based learning media had a significant positive effect on students' mathematics learning motivation. Therefore, this learning media can be recommended as an innovative, low-cost, environmentally friendly, and effective alternative for enhancing mathematics instruction in junior high schools

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INTRODUCTION

Mathematics is a discipline that plays an essential role in developing students' ability to think logically, critically, systematically, and creatively. The primary objective of mathematics education at the junior high school level is to help students understand mathematical concepts, solve problems, and apply mathematical knowledge in their daily lives. However, many students experience difficulties in understanding mathematical concepts because of their abstract nature, which consequently affects their interest and learning outcomes. Mathematics is often perceived as one of the most challenging subjects by students due to differences in their reasoning and logical thinking abilities. Therefore, mathematics instruction is essential for developing students' higher-order and critical thinking skills in solving mathematical problems (Astria et al., 2023).

One of the factors influencing students' achievement in mathematics learning is the appropriate use of instructional media. Instructional media serve as an effective means of delivering learning materials in mathematics because they enable students to understand the content more easily. The use of instructional media helps teachers present abstract mathematical concepts in a more concrete, engaging, and understandable manner. Furthermore to enhance students' learning motivation, active and involvement during the learning process, more attractive instructional media are needed.

To overcome these problems in mathematics, an alternative that teachers can take to improve the quality of mathematics learning is to be able to create learning media that can be utilized in the learning process. One of the learning media that can be used in mathematics learning is recycled material media. Recycled material media are learning media made from used materials that can still be reused, such as cardboard, plastic bottles, bottle caps, straws, used paper and various other materials. In addition to being easy to obtain and economical, the use of recycled material media also supports environmental education by fostering an attitude of concern for the management of non-organic waste and the reuse of used material.

In mathematics learning recycled materials media can be used as teaching aids to help students understand various mathematical concepts, including plane figures, solid figures, fractions, ratios and measurement. Through the use of these media, students can learn in a more concrete and active way, thereby improving their conceptual understanding and mathematics learning outcomes. In addition, students' involvement in the creation and use of recycled materials media is also highly beneficial in enhancing their creativity, cooperation and learning motivation.

In junior high school mathematics learning the use of recycled materials media has become an alternative that can be implemented to create more engaging and meaningful teaching and learning activities. Learning media made from recycled materials not only help students understand mathematical concepts more concretely but also foster creativity and environmental awareness. Therefore, this study was conducted to examine the effectiveness of recycled materials media in mathematics learning. In addition, this study aims to increase students' learning motivation by implementing learning media designed based on recycled materials.

A previous study by Sari et al., (2020) showed that the use of recycled cardboard as a geometry model was able to increase the learning motivation of junior high school students by up to 25%. The main difference between this study and previous research lies in its focus, namely students' learning media that are directly created and utilized during the teaching and learning process. Furthermore, this study focuses on students' learning motivation rather than

solely on learning outcomes. In addition, the recycled materials learning media are not only used by the teacher but are not only used by the teacher but are also directly created and utilized by the students during the learning process, thereby increasing their interest, attention and active participation throughout the teaching and learning activities. One example of recycled inorganic material is used cardboard, which serves as the primary learning media for teaching the topic of solid figure nets. Theoretically, Bruner (1966) explained that conceptual understanding becomes deeper when students learn through direct activities that are related to their daily lives. In line with this view, Dienes (1971) stated that mathematics learning is more effective when abstract concepts are introduced through concrete representations, allowing students to understand the concepts gradually. In addition, Arsyad (2017) emphasized that learning media derived from the surrounding environment, including recycled materials, can increase students' interest and learning motivation because they are closely related to their everyday experiences.

Based on observation conducted at the school, problems were identified in the topic of solid figures. Students had difficulty understanding the concepts of solid figures because the teaching and learning process was still dominated by a conventional teacher-centered approach that relied on textbooks and memorization. As a result, students were less motivated to learn, leading to a lower level of understanding of the material. To address this problem, a learning approach that can enhance students' motivation will be implemented through the use of recycled material learning media in teaching the topic of solid figures. Therefore, the purpose of this study is to examine the effect using recycled materials learning media on junior high school students' motivation to learn mathematics. Specifically, this study focuses on analyzing changes in students' motivation to learn mathematics before and after the implementation of recycled material learning media in the teaching and learning process.

Furthermore, according to learning media theory, teaching aids are tools that can be used to deliver instructional information in ways that attract students' thoughts, feelings and learning process (Arsyad, 2017). Students' learning motivation in the classroom is greatly influenced by the use of learning media. This is supported by a study conducted by (Agus Supriadi and Abdul, 2022), which concluded that the null hypothesis (H_0) was rejected and the alternative hypothesis (H_a) was accepted, indicating that there was a significant effect of the use of learning media on students' learning motivation in the classroom. Therefore, the use of learning media can be considered one of the effective efforts to improve both students' learning motivation and learning outcomes. Mathematics learning motivation refers to the internal drive that influences students' willingness to learn, understand and solve various mathematical problems.

Hamid (2025) stated that students' learning motivation increases through the use of learning media, as learning activities become more engaging and the learning environment becomes more conducive, enabling students to learn effectively. On the other hand, mathematics learning that is monotonous and overly abstract tends to reduce students' learning motivation. The application of creative teaching aids, including the use of learning media made from recycled materials, can create a more enjoyable and participatory classroom atmosphere, thereby increasing students' motivation to learn mathematics. Therefore, the researcher is interested in conducting a study entitled "The Effect of Using Recycled Materials Learning Media on Junior High School Students' Mathematics Learning Motivation".

RESEARCH METHODOLOGY

The study employed a quantitative research approach using an experimental method, The research design used was a Pre-Experimental Design in the form of a One-Group Pretest-

Posttest Design. This design was selected because the study did not involve a control group and used only one group namely the experimental group. The research procedure began by administering a pretest to the students before the treatment a posttest was given. After the treatment a posttest was administered to obtain conclusions regarding the effects of the treatment. The pretest and posttest used in this study were in the form of a Students Learning Motivation Questionnaire. This design helps provide a more accurate comparison of the conditions before and after the treatment was administered (Rahmayani et al., 2019).

Research Location and Time

This study was conducted at SMP Babul Istiqamah Susoh during the second semester of the 2025/2026 academic year. The selection of the research site was based on the results of preliminary observations conducted during the Teaching Assistance Program. The observations indicated that students were less motivated and tended to feel bored during mathematics learning because the teacher primarily used the lecture method throughout the teaching and learning process. As a result, students showed less enthusiasm and lower motivation to learn mathematics.

Research Population and Sample

The population in this study consisted of all ninth-grade students at SMP Babul Istiqamah Susoh totaling 16 students. The sampling technique employed was non-probability sampling, specifically total sampling (saturated sampling). Total sampling was used because the number of respondents was referred to as saturated sampling because all members of the population were included as the research sample, considering that the population size was insufficient (Afifah & Hartatik, 2019).

Research Instrument

The data were collected using a non-test instrument in the form of a learning motivation questionnaire administered before and after the implementation of learning media from recycled materials. To obtain the required data, two types of non-test instruments were used namely the pre-test and post-test. The pre-test was a learning motivation questionnaire administered to obtain information regarding the students' initial level of learning motivation. Meanwhile, the pos-test was used to determine the students' final learning motivation after they had received the treatment using recycled-material-based learning media. Research instruments are used as tools to assist researchers in collecting data (Syahroni, 2022). The instrument used in this study was a non-test instrument in the form of a pretest-posttest learning motivation questionnaire. The function of this questionnaire was to determine the effect of the intervention on students' learning motivation. The data were analyzed using parametric tests. Before conducting the parametric test, a normality test was performed to examine whether the data met the assumptions of normally distributed, the Paired Sample T-test was applied. However, if the data did not meet the normality assumption, the Wilcoxon Signed-Rank Test was used (Astuti et al., 2021). All statistical analyses were conducted using SPSS version 27.

Data Collection Technique

The data were collected using pretest and posttest research instruments in the form of a learning motivation questionnaire. The questionnaires consisted of 16 statements, including 10 positive statements and 6 negative statements and had undergone validity testing involving one academic lecturer and one mathematics teacher. According to (Waruhu et al., 2025),

validity and reliability are two essential aspects of quantitative research to ensure that the research instrument is capable of producing accurate and reliable data. The learning motivation questionnaire used a five-point Likert scale (1-5). The alternative response scores for the positive and negative statements are presented as follows.

Table 1 : Likert Scales Response Score

Positive Statements		Negative Statements	
Answer	Score	Answer	Score
Strongly Agree (SA)	5	Strongly Agree (SA)	1
Agree (A)	4	Agree (A)	2
Natural (N)	3	Natural (N)	3
Disagree (D)	2	Disagree (D)	4
Strongly Disagree (SD)	1	Strongly Disagree (SD)	5

In this study, learning motivation was classified into five criteria, very high, high, moderate, low and very low. According to Arifin (Yenni & Sukmawati, 2020), the criteria of learning motivation were analyzed based on the number of questionnaire items and the response options provided. Based on the calculation result, the following intervals were obtained.

Table 2 : Learning Motivation Criteria

No	Interval	Criteria
1.	68-80	Very High
2.	55- 67	High
3.	42- 54	Moderate
4.	29- 41	Low
5.	16- 28	Very Low

This study employed a quantitative research method using a pre-experimental design based on a one-group pretest-posttest design. The population consisted of all ninth-grade students at SMP Babul Istiqamah Susoh. The sample was selected using a non-probability sampling procedure, focusing on a single experimental class.

The hypotheses proposed in this study were as follows:

Ho = **There is no** difference in students' mathematics learning motivation before and after the implementation of learning media made from recycled materials.

Ha = **There is a** difference in students' mathematics learning motivation before and after the implementation of learning media made from recycled materials.

The decision criterion for Ho was as follow : Ho was rejected if the significance value (Sig.) < 0,05

RESULTS AND DISCUSSION

Learning Motivation Questionnaire Data

Learning motivation was assessed using a questionnaire administered before and after the implementation of learning media made from recycled materials. The questionnaire data collected from the ninth-grade students of SMP Babul Istiqamah Susoh were first analyzed using descriptive statistics to provide an overview of the effectiveness of using recycled

materials learning media on students' learning motivation. The result of the descriptive statistical analysis of the learning motivation questionnaire data are presented below.

Table 3 : Descriptive Statistics Analysis of the Pretest

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
P1	16	1	4	32	2.00	.816
P2	16	1	3	32	2.00	.730
P3	16	1	4	32	2.00	1.033
P4	16	1	4	33	02.06	1.124
P5	16	1	5	41	2.56	1.413
P6	16	1	5	39	2.44	1.209
P7	16	1	5	40	2.50	1.414
P8	16	1	4	32	2.00	.966
P9	16	1	4	38	2.38	1.088
P10	16	1	5	43	2.69	1.448
P11	16	1	4	35	2.19	1.047
P12	16	1	5	46	2.88	1.088
P13	16	1	4	34	2.13	1.025
P14	16	1	5	36	2.25	1.125
P15	16	1	5	40	2.50	1.592
P16	16	1	5	43	2.69	1.702
TOTAL	16	27	49	598	37.38	5.439
	16					

Source : Data processing using SPSS

Table 3 presents the result of data processing on the level of students' learning motivation before the implementation of learning media from recycled material using SPSS version 27. The result indicated that the lowest motivation score was 27, while the highest score was 49. The mean score of students' learning motivation before the treatment was 37.38 with a standard deviation of 5.439.

Table 4 : Descriptive Statistics Analysis of the Posttest

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
P1	16	1	5	58	3.63	1.310
P2	16	2	5	66	4.13	.957
P3	16	1	5	53	3.31	1.250
P4	16	2	5	65	04.06	.929
P5	16	3	5	67	4.19	.750
P6	16	1	5	48	3.00	1.211
P7	16	2	5	70	4.38	.885

P8	16	1	5	57	3.56	1.094
P9	16	1	5	54	3.38	1.147
P10	16	1	5	61	3.81	1.109
P11	16	1	5	59	3.69	1.250
P12	16	1	5	54	3.38	1.455
P13	16	3	5	68	4.25	775
P14	16	1	5	66	4.13	719
P15	16	1	5	51	3.19	1.328
P16	16	2	5	64	4.00	1.095
TOTAL	16	45	72	943	58.94	7.945
Valid N (listwise)	16					

Source : Data processing using SPSS

Table 4 presents the result of data processing on the level of students' learning motivation after the implementation of learning media from recycled materials using SPSS version 27. The result indicated that after the treatment was administered the lowest motivation score increased to 45 while the highest score reached 72. The mean score of students' learning motivation significantly increased to 58.94 with a standard deviation of 7.945

Based on the learning motivation categories, the levels of students' learning motivation before and after the use of learning media from recycled materials were obtained. The result of these categories can be observed in the following table.

Table 5 : Categories of Students' Learning Motivation Before and After Treatment

Interval	Category	Before		After	
		Frequency	Percentage	Frequency	Percentage
68-80	Very High	0	0%	2	12,50%
55- 67	High	0	0%	10	62,50%
42- 54	Moderate	3	18,75%	4	25%
29- 41	Low	12	75%	0	0%
16- 28	Very Low	1	6,25%	0	0%

Table 5 presents the distribution and percentage of students' learning motivation based on the data obtained from the learning motivation questionnaire. The results indicate a change in students' learning motivation categories before and after the implementation of learning media from recycled material. In the Very High category no students (0%) in this category before the treatment, whereas after the treatment the number increased to 2 students (12,50%). In the High category there were no students (0%) before treatment however, after the treatment this category became the majority with 10 students (62,50%). In the Moderate category there were 3 students (18, 75%) before the treatment and the number increased slightly to 4 students (25%) after the treatment. In the low category there were 12 students (75%) before the treatment, but this number decreased dramatically to 0 students (0%) after the treatment. Finally, in the Very Low category there was 1 student (6,25%) before the treatment and after the treatment , no students (0%) remained in this category.

The following is a diagram showing the percentage of students' learning motivation levels.

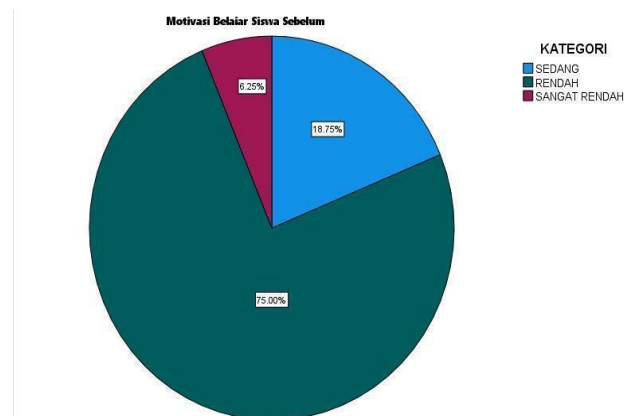


Figure 1 : Diagram of Students' Learning Motivation Before the Treatment

Figure 1 illustrates students' learning motivation before the implementation of learning media from recycled materials. The result shows that most students were in the Very Low (6,25%), Low (75%) and Moderate (18,75%) motivation categories. Meanwhile, no students were classified in the High or Very High categories (0%). These findings indicate that, before the learning process using recycled-material learning media, students had little interest in learning mathematics, particularly the topic of solid geometry. During classroom activities, many students showed low enthusiasm and often did not pay attention when the teacher explained the material. Therefore, it can be concluded that the students; learning motivation in this class was very low before the implementation of learning media from recycled materials.

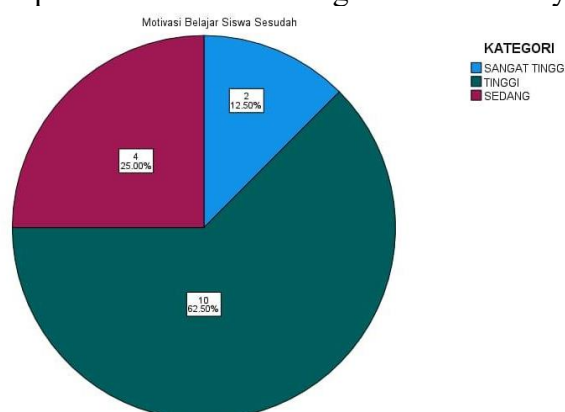


Figure 2 : Diagram of Students' Learning Motivation Before the Treatment

Figure 2 illustrates students' learning motivation after the implementation of learning media from recycled materials. The results show a noticeable improvement in students' learning motivation, with 12,50% of students classified in the Very High category, 62,50% in the High category and the remaining 25% in the Moderate category. Meanwhile, no students (0%) were classified in either the Low or Very Low categories. These findings indicate that, after the implementation of the recycled-material learning media, students became more active during the learning process and felt more confident when solving mathematical problems. In addition, students paid closer attention to the teacher's explanations and actively followed the lesson. Therefore, it can be concluded that the implementation of learning media from recycled materials significantly improved students' learning motivation.

Data Analysis of Non-test Score Pretest and Posttest Motivation Questionnaires

The following is a summary of the pretest score obtained from the Learning Motivation Questionnaire administered to grade IX students at SMP Babul Istiqamah Susoh. These data

were collected and summarized to facilitate the analysis process in the subsequent stages of the research.

Table 6 : Summary of Non-test Result Motivation Questionnaire Pretest and Posttest Score

Name	Pretest	Posttest
DQ	46	65
MF	37	63
LN	35	55
RS	38	58
Z	38	52
HF	36	59
IK	31	45
RD	42	66
MN	39	49
M	39	72
SH	39	61
MS	31	50
ST	36	55
KZ	27	56
AB	35	72
TR	49	65

The pretest and posttest scores from the learning motivation questionnaire presented in table 6 were analyzed using a normality test. The purpose of this test was to determine whether the analyzed data were normally distributed, which is one of the assumptions that must be satisfied before conducting a parametric test such as the Paired Sample T-test. In this study, the normality test was performed using both the Shapiro-Wilk and Kolmogorov-Smirnov test study sample consisted of 16 participants, which is fewer than 50. The results are presented below.

Table 7 : Normality Test Result

Motivation to Learn	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Learning Motivation Outcome - Pretest	.195	16	.105	.959	16	.639
Posttest	.090	16	.200	.972*	16	.874

Source : Data processing using SPSS

Referring to the results of the Normality Test table above, the pretest learning motivation obtained a significance value of 0,105 in the Kolmogorov-Smirnov test and 0,639 in the Shapiro-Wilk test. Since the Shapiro-Wilk significance value of 0,639 > 0,05, it can be concluded that the pretest learning motivation data are normality distributed. The posttest learning motivation obtained a significance value of 0,200 in the Kolmogorov-Smirnov test and 0,874 in the Shapiro-Wilk test. The Kolmogorov-Smirnov significance value 0,200 indicates the upper reporting limit, showing that the posttest learning motivation data are also normality distributed. Since the pretest and posttest data are normality distributed, the normality assumption required for the parametric test has been satisfied. Therefore, the hypothesis test for the difference in the mean scores before and after the treatment can be continued using the Paired Sample T-test.

Table 8 : Paired Sample T-test Results

	Mean	Std. Deviation	Std Error Mean	Lower	Upper	t	df	Sig (2- tailed)
Motivation Pretest - Motivation Posttest	- 21.562	7.099	1.775	-25.345	-17.780	- 12.150	15	<,00 1

Source : Data processing using SPSS

Based on the results of Paired Sample T-test presented in table 8, the calculated t-value was -12.150, with a significance value of Sig. (2-tailed) <,001. Since the significance value is less than 0,05, H_0 is rejected and H_a is accepted. These results indicate that there is a statistically significant difference in students' learning motivation. The mean difference of -21.562 indicates that the treatment learning motivation scores were higher than the pre-treatment scores. Therefore, the use of learning media from recycled materials has been proven to have a statistically significant effect on students' mathematics learning motivation.

Discussion

This study aimed to examine the effect of using learning media from recycled materials in mathematics instruction on the learning motivation of grade IX students at SMP Babul Istiqamah Susoh. The results of the questionnaire administered to the students demonstrate an increase in their learning motivation after the implementation of recycled materials based learning media in teaching the topic of solid geometry.

Based on the results of the questionnaire administered before the treatment, the majority of students were classified as having moderate learning motivation (18,75%) and low learning motivation (75%), while only a small proportion fell into the very low motivation category (6,25%). However, after the implementation of learning media from recycled materials, there was a substantial improvement in students' learning motivation. No students remained in the low or very low motivation categories. Instead, they shifted to the very high (31,25%), high (43,75%) and moderate (25%) motivation categories. These findings indicate that the implementation of learning media from recycled materials had a positive effect on enhancing students' enthusiasm and interest in learning. The findings of this study are consistent with previous research. (Zulfikar & Khairul, 2025) reported that the use of non-organic waste as mathematics learning media made a positive contribution to improving the quality of the learning process., as evidenced by increased student participation. Similarly, (Fatin et al., 2024) found that the utilization of recycled waste in mathematics learning was highly effective, as reflected in students' positive responses during the learning process, which in turn enhanced their learning motivation in the classroom.

Conclusions

Referring to the finding of this study, it can be concluded that the implementation of learning media from recycled materials had a substantial effect on improving the learning motivation of grade IX students at SMP Babul Istiqamah Susoh. This improvement was evidenced by changes in the students' learning motivation categories as well as the statistical test results, which indicated a significant difference between the motivation levels before and after the implementation of the learning media. Therefore, recycled material based learning media can be considered a creative alternative for mathematics teaching and learning activities in schools.

Acknowledgements

Among all the pages in this article, the acknowledgement section is the most meaningful, as it is here that the author expresses gratitude for what words can fully convey. To my mother, thank you for your endless prayers and the unwavering trust you have always placed in me. Your love, sacrifice and encouragement have been my greatest source of strength throughout this journey. To my father, although your passing remains a profound sorrow, your memory continues to be my greatest source of motivation and inspiration. Your presence lives on in every step I take. To my family, thank you for always believing in me and strengthening me through your prayers. You are where every journey begins and where every moment of exhaustion longs to return. Thank you for providing me with something far more valuable than knowledge—a heart that always strives to give and a spirit that is shaped to be of service to others. To my friends, from our first semester together to the sigh of relief at the end of the eighth semester, you have always been part of this journey. Thank you for being both witnesses to and companions in this process, for every meaningful discussion that inspired new eased the challenges along the way. My sincere gratitude goes to Mr. Baidullah, M.Pd, my supervisor, for his invaluable guidance, knowledge and support throughout the preparation of this article. Thank you for your patience, dedication and sincere mentorship. To my beloved, thank you for your constant support, encouragement and motivation. Thank you for always believing in me and reminding me that I was capable of completing this work. Finally, I would like to thank myself. Thank you, Tuti Alawiyah, for choosing not to give up. Thank you for fighting with remarkable strength and perseverance. You have proven that you are far stronger than you ever imagined.

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