The Effect of Instructional Videos On Students' Learning Outcomes In Cell Biology In Grade XI at SMA Negeri 6 Pematangsiantar

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Abstract.
This study aimed to determine the effect of instructional videos on students' learning outcomes in cell biology, particularly animal and plant cells, among Grade XI students at SMA Negeri 6 Pematangsiantar. The study employed a quantitative experimental approach using a pre-test and post-test control-group design. The sample consisted of 71 students: 35 students in class XI M3 as the experimental group, which learned with instructional videos, and 36 students in class XI M4 as the control group, which learned without instructional videos. Data were collected through learning-outcome tests and analyzed using the Mann–Whitney U test because the normality results indicated that the data were not normally distributed. The thesis reports that the experimental group's mean score increased from 26.57% on the pre-test to 79.00% on the post-test. The control group increased from 25.42% to 49.47% in the results section. The Mann–Whitney test produced U = 118.500, Z = −6.017, and an asymptotic two-tailed significance value reported as 0.000 (p < 0.001). These findings indicate a statistically significant difference in learning outcomes between the two groups and support the use of instructional videos in teaching cell biology. The control-group post-test percentage requires confirmation because the thesis conclusion gives a different figure (48.47%).
Keywords: *instructional video; learning outcomes; cell biology; animal cells and plant cells.*

I. INTRODUCTION

Biology learning requires students to understand both observable phenomena and concepts that cannot be directly seen. Cell biology is one such topic because cell structures and organelles are microscopic, while their functions are essential to understanding the organization and activities of living organisms. Students may therefore experience difficulty connecting abstract explanations with the structures and functions of cells [1].

Learning media can support the presentation of subject matter and help teachers communicate concepts more clearly. Audio-visual media combine visual information and sound, allowing students to observe representations of objects and processes while listening to explanations. Instructional videos may therefore provide an alternative to lessons that rely mainly on textbooks, verbal explanations, and board work [2].

At SMA Negeri 6 Pematangsiantar, preliminary observations described in the thesis indicated that biology lessons commonly relied on the board, markers, textbooks, and lecture-based instruction. The school's biology minimum competency criterion (KKM) for Grade XI was 75. The preliminary data recorded 11 students meeting the criterion and 24 not meeting it in class XI M3, while 14 students met it and 22 did not in class XI M4. These conditions provided the context for examining whether instructional videos could support students' learning outcomes in cell biology.

Instructional videos can present cell structures and their organization through moving images, narration, and visual explanations. Previous work cited in the thesis has discussed the use of video in biology learning and media for teaching cell material [3,4]. In particular, visual representations may help learners observe structures that are difficult to examine directly in a classroom setting.

Based on this background, this study aimed to determine the effect of instructional videos on students' learning outcomes in cell biology, focusing on animal and plant cells, among Grade XI students at SMA Negeri 6 Pematangsiantar in the 2026/2027 academic year.

II. METHODS

This study used a quantitative experimental approach with a pre-test and post-test control-group design, as described in the thesis. The research was conducted at SMA Negeri 6 Pematangsiantar, North Sumatra, Indonesia, from 16 September to 14 October 2026, during the 2026/2027 academic year.

The population comprised all Grade XI students at SMA Negeri 6 Pematangsiantar, totaling 212 students across six classes. The study sample consisted of 71 students in two classes. Class XI M3, comprising 35 students, served as the experimental group and received instruction using an instructional video. Class XI M4, comprising 36 students, served as the control group and received instruction without an instructional video, using classroom explanation and printed biology textbooks.

Both groups completed a pre-test and a post-test on animal and plant cell material. The learning-outcome instrument consisted of 20 multiple-choice items selected after an item try-out. The thesis reports that 25 items were tested with 35 Grade XII students; 20 items were classified as valid and five as invalid. The reported Cronbach's alpha was 0.818.

Data were collected through tests, classroom observation, and documentation. The test scores were used to describe students' learning outcomes before and after the instructional treatment. Statistical analysis was conducted using SPSS. The Shapiro–Wilk normality results showed that not all score groups were normally distributed; therefore, the Mann–Whitney U test was used to compare the independent experimental and control groups. Statistical significance was evaluated at the 0.05 level.

III. RESULTS AND DISCUSSION

The study involved 71 Grade XI students: 35 in the experimental class (XI M3) and 36 in the control class (XI M4). The experimental class learned the animal and plant cell topic using an instructional video, whereas the control class learned the same topic without video media.

The pre-test and post-test percentages reported in the results section are presented in Table 1. The experimental group showed a larger increase than the control group.

Table 1. Students' learning outcomes before and after instruction

Group	n	Pre-test (%)	Post-test (%)	Increase (percentage points)
Experimental (XI M3)	35	26.57	79.00	52.43
Control (XI M4)	36	25.42	49.47*	24.05

**The results section and figure discussion report 49.47% for the control-group post-test, whereas the thesis conclusion states 48.47%. The original score summary should be checked before journal submission.*

The experimental group's post-test percentage was 79.00%, compared with 26.57% on the pre-test. The control group's reported post-test percentage was 49.47%, compared with 25.42% on the pre-test. This descriptive pattern indicates a greater improvement in the class that used instructional videos. The video may have helped students visualize cell structures and distinguish the components of animal and plant cells. However, the interpretation should be limited to the measured learning outcomes; the study did not report a separate measurement of motivation or student preference.

The Shapiro–Wilk test results are summarized in Table 2. The significance values for the control pre-test, experimental pre-test, and experimental post-test were below 0.05, while the control post-test value was above 0.05. Thus, the normality assumption was not met by all groups.

Table 2. Shapiro–Wilk normality test results

Score group	n	Shapiro–Wilk statistic	Sig.
Control pre-test	36	0.839	0.000
Control post-test	36	0.981	0.791
Experimental pre-test	35	0.937	0.045
Experimental post-test	35	0.916	0.011

The homogeneity test reported a Levene significance value of 0.000 (based on the mean), indicating unequal variances under the 0.05 criterion. The thesis then reports the Mann–Whitney U test for the comparison between the two independent classes. Its results are shown in Table 3.

Table 3. Mann–Whitney U test results

Statistic	Value
Mann–Whitney U	118.500
Wilcoxon W	784.500

Z	−6.017
Asymptotic significance (two-tailed)	0.000

The reported asymptotic significance value of 0.000 should be interpreted as $p < 0.001$ rather than an exact probability of zero. Because $p < 0.05$, the null hypothesis of no difference between the groups is rejected. The result indicates a statistically significant difference in learning outcomes between the experimental and control classes. Together with the higher post-test percentage in the experimental group, this finding supports the conclusion that the use of instructional videos was associated with better learning outcomes in this study.

A point requiring editorial verification is the control-group post-test percentage: the results discussion reports 49.47%, while the conclusion section reports 48.47%. In addition, the article should retain the correct treatment allocation consistently: XI M3 was the video-based experimental class and XI M4 was the non-video control class. The manuscript follows the methods and results description for this allocation.

IV. CONCLUSION

The study found a statistically significant difference in learning outcomes between Grade XI students who learned cell biology using instructional videos and those who learned without instructional videos at SMA Negeri 6 Pematangsiantar. The experimental group's reported score increased from 26.57% on the pre-test to 79.00% on the post-test, while the control group increased from 25.42% to 49.47% according to the results section. The Mann–Whitney U test yielded $U = 118.500$, $Z = -6.017$, and $p < 0.001$. These findings support the use of instructional videos as a learning medium for animal and plant cell material. The control-group post-test percentage must be verified against the original dataset before submission.

V. ACKNOWLEDGMENTS

The author would like to thank SMA Negeri 6 Pematangsiantar for the opportunity and support to conduct the research, the biology teacher and participating students for their cooperation, and the supervisors and the Biology Education Study Program of Universitas HKBP Nommensen Pematangsiantar for their guidance.

REFERENCES

[1]. [1] N. Azizah and H. Alberida, "What Are the Problems of Biology Learning among Senior High School Students?," ***Journal for Lesson and Learning Studies***, vol. 4, no. 3, pp. 388–395, 2021, doi: 10.23887/jlls.v4i3.38073.

[2]. [2] A. S. Sadiman, R. Rahardjo, A. Haryono, and Harjito, Media Pendidikan: Pengertian, Pengembangan dan Pemanfaatannya. Jakarta: PT RajaGrafindo Persada, 2022.

[3]. [3] L. Fitriani et al., "The effect of using instructional videos on high school students' biology learning outcomes," ***Jurnal Pendidikan Biologi Indonesia***, vol. 8, no. 1, pp. 45–53, 2022. [Bibliographic details and author initials should be checked against the original publication.]

[4]. [4] F. Nisa, R. Ro'ifah, S. Indarti, and L. Annahaar, "The effect of 3D-based biology learning media on cell material for Grade XI students at SMA Muhammadiyah 4 Surabaya," ***J-SES: Journal of Science, Education, and Studies***, vol. 2, no. 2, pp. 25–30, 2023.