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The Effectiveness of Digital Flipbook Media in Vocational Technical Drawing Education

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ABSTRACT

This research is motivated by the low learning outcomes of students in the Technical Drawing subject at Vocational Schools due to the dominance of conventional methods that are less able to visualize objects comprehensively. The purpose of this study is to analyze the effect of using digital flipbook learning media on the learning outcomes of class X students of Welding Engineering Expertise Concentration at SMK Negeri 10 Malang. The research method used is quantitative with a One Group Pretest-Posttest design on 70 students selected through a total sampling technique. The research instrument is a validated multiple-choice objective test, and the data are analyzed using the Paired Sample T-Test and N-Gain tests. The results of the study showed a significant increase in the average value from 79.91 to 90.89 with a significance value of 0.000 ($p < 0.05$). The effectiveness of media use is in the "Medium" category with an average N-Gain of 0.5611. The conclusion of this study states that digital flipbook media has a real influence in improving students' conceptual understanding and cognitive achievement in technical drawing competencies. This media is recommended as a strategic tool to support innovative digital learning transformation in the Independent Curriculum era.

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1. INTRODUCTION

Vocational education plays a strategic role in preparing competent, adaptive, and work-ready human resources to meet the ever-evolving needs of the industrial world [1]. Through vocational education, students are guided to achieve a balance between mastery of practical skills and understanding of theoretical concepts that support professional performance in their respective fields of expertise. Therefore, the quality of the learning process in Vocational High Schools (SMK) is a crucial factor in determining graduates' readiness to face the world of work and continue their education.

Vocational schools are designed to produce graduates who are not only technically superior but also possess logical, analytical, and visual thinking skills. These skills are highly sought after in engineering and manufacturing, which demand precision, accuracy, and an understanding of industry standards. One fundamental subject that plays a crucial role in developing these competencies is technical drawing, which serves as the primary language of communication in the engineering world [2].

Learning technical drawing requires students to understand geometric concepts, read symbols and drawing standards, and interpret working drawings systematically and accurately. These skills are essential prerequisites before students enter practical activities in workshops or the industrial world [3]. Therefore, learning outcomes in this subject are measured not only by drawing ability, but also by conceptual understanding, accuracy in reading drawings, and visual interpretation skills according to engineering standards [4].

However, the reality on the ground shows that learning technical drawing still faces various obstacles. The learning process tends to be dominated by conventional teacher-centered methods, with the use of learning media limited to textbooks and presentation slides [5]. This condition causes student engagement in learning to be low, so that students tend to be passive and experience difficulties in understanding the relationship between real objects and technical drawing representations [6].

The abstract and visual nature of technical drawing material requires the use of learning media that can present information in a concrete, systematic, and interactive manner [7]. Without the support of appropriate media, students will have difficulty visualizing three-dimensional objects, understanding image projections, and interpreting technical symbols correctly.

Theoretically, learning technical drawing is in line with the constructivist approach which emphasizes that knowledge is actively constructed by students through meaningful learning experiences [8]. In addition, the Cognitive Theory of Multimedia Learning states that presenting material through a combination of complementary text, images, and visuals can improve understanding and reduce students' cognitive load [9]. Therefore, the use of digital learning media is a relevant solution to improve the quality of learning, especially for visual materials.

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In line with the implementation of the Independent Curriculum, learning in vocational schools is required to be student-centered and utilize digital technology optimally [10]. Digital learning media allows for more interactive, flexible, and contextual presentation of material according to students' learning needs [11].

One digital learning medium that has the potential to support this learning is the digital flipbook. Flipbooks are interactive e-book-based media that integrate text, images, animations, and videos in one dynamic learning platform [12]. In technical drawing learning, flipbooks can present technical drawing illustrations, projected animations, and procedural videos visually, thus helping students understand concepts more deeply [13]. In addition, flipbooks can be accessed anytime and anywhere, thus supporting independent learning.

Several previous studies have shown that the use of digital flipbooks can improve student engagement and learning outcomes [14]. Furthermore, flipbooks have also been shown to be more effective than printed modules in improving understanding of visual concepts [15]. However, most of these studies are still general in nature and have not specifically examined the effectiveness of digital flipbooks in the context of technical drawing learning in vocational schools, which have more complex visual-spatial characteristics and industry standards. Furthermore, previous studies have not used a quantitative approach through experimental designs to measurably measure improvements in learning outcomes [16].

Thus, there is still a research gap regarding the use of digital flipbooks to improve student learning outcomes in technical drawing subjects in vocational education. Therefore, this study aims to analyze the effect of using digital flipbook learning media on student learning outcomes in technical drawing subjects in vocational high schools.

The results of this study are expected to provide theoretical contributions in the development of digital learning media studies in vocational education, as well as practical contributions for teachers in selecting and developing effective learning media to improve student learning outcomes.

2. RESEARCH METHODS

This research uses a quantitative approach with a descriptive design. Pre-experimental through the model one group pretest–posttest design. This design was used to identify the effect of using digital flipbook learning media on student learning outcomes by comparing scores before and after treatment [17]. The research was conducted at SMK Negeri 10 Malang in the even semester of the 2024/2025 academic year.

The research subjects were 70 class X students of the Welding Engineering expertise program. The sampling technique used was total sampling, that is, the entire population is used as a sample because the number of subjects is relatively limited and in accordance with the research objectives.

The research procedure begins with the provision of pre test to measure students' initial abilities in technical drawing material. Next, learning was carried out using digital flipbook media containing material on line types, technical drawing symbols, sizing rules, and working drawing interpretation. After the treatment was given, students participated in post test to measure improvement Learning outcomes. Measurement focuses on cognitive aspects, including the ability to identify line types, recognize technical drawing symbols, understand sizing rules, and read and interpret working drawings.

The research instrument was a 25-item multiple-choice objective test based on learning achievement indicators in the Independent Curriculum. The instrument's validity was tested through expert judgment by technical drawing subject teachers to ensure the suitability of the content and clarity of the test items. In addition, the instrument reliability test was conducted using the coefficient Cronbach's Alphato measure the internal consistency of the instrument. The results of the reliability test show that the Cronbach's Alpha value is 0.746, so that the research instrument is included in the category reliable.

Table 1. Results of Instrument Reliability Test

Instrument	Cronbach's Alpha	Category
Learning Outcome Test	0.746	Reliable

Data analysis was performed using IBM SPSS Statistics version 26. Level up The analysis included descriptive statistics to describe the distribution of the data, including the mean, minimum and maximum values, and standard deviations of the pretest and posttest scores. Furthermore, a normality test was conducted as a prerequisite to determine the feasibility of using parametric statistical tests.

To measure the improvement in student learning outcomes after treatment, analysis was used. Normalized Gain (N-Gain). The N-Gain value is calculated to determine the level of improvement in learning outcomes between the pretest and posttest and to categorize it into levels of learning effectiveness based on Hake's (1999) criteria, namely low, medium, and high categories.

The overall research procedure included preparation, instrument validation, pretest administration, treatment using digital flipbooks, posttest administration, data analysis, and conclusion drawing. The research flow is presented in diagrammatic form in Figure 1. The following is Research flowchart:

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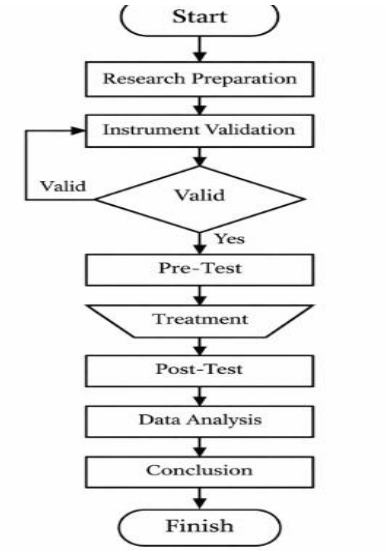


Figure 1. Flowchart

3. RESULTS AND DISCUSSION

This section presents data analysis on the learning outcomes of vocational school students in the Technical Drawing subject obtained from pre-test and post-test tests.

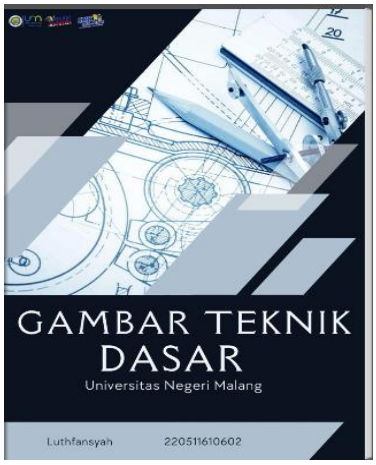


Figure 2. Flipbook Media

Figure 3.1 shows the digital flipbook learning media used in the study. This media contains Basic Engineering Drawing material presented visually and systematically as a form of treatment to improve student learning outcomes.

The findings are arranged based on the sequence of the research flow diagram, including data description, testing (Descriptive, Normality, Homogeneity, N-Gain T-Test), and hypothesis testing regarding the influence of media on improving learning outcomes.

Table 2. Descriptive Test

Variables	N	Min	Max	Mean	Std. Deviation
Pre Test	70	74	85	79,91	2.276
Post Test	70	84	95	90,89	2.429

Based on the descriptive statistical test table, the results of the analysis show that the average pretest score of students in the technical drawing subject is 79.91 with a standard deviation of 2.276, while the average posttest score increased to 90.89 with a standard deviation of 2.429. The pretest score range is in the interval of 74 to 85, while the posttest score is in the interval of 84 to 95. The increase in the average score and score range indicates that after the use of digital Flipbook learning media, students' ability to understand technical drawing material has increased quite significantly. The relatively small standard deviation in both measurements indicates that the variation in scores between students is not too large, so that student learning outcomes tend to be homogeneous.

These findings indicate that the use of digital flipbook learning media can have a positive impact on student learning outcomes in general, thus potentially improving the overall quality of technical drawing learning [18]. To ensure that this average increase is statistically reliable, a prerequisite analysis test was conducted, starting with a data normality test.

Table 3. Normality test

Variables	Test Statistics	Sig. (2-tailed)	Interpretation
Pre Test	0.098	0.095	Normal
Post Test	0.105	0.052	Normal

A normality test was conducted as a prerequisite to determine the type of statistical analysis used in this study. The results of the normality test using the One-Sample Kolmogorov-Smirnov Test showed that the significance value for the pretest was 0.095 and the posttest was 0.052. Since both significance values were greater than 0.05, the pretest and posttest data values were declared normally distributed. This fulfills the basic assumptions of using parametric statistical tests. Fulfilling these assumptions is very important to ensure that the results of the statistical tests obtained have high validity and reliability in drawing scientific conclusions [19]. In addition to normal data distribution, another requirement that must be met in parametric analysis is the equality of data variance, as indicated by the homogeneity test.

Table 4. Homogeneity Test

Variables	Levene Statistic	df1	df2	Say.	Interpretation
Value (Based on Average)	0.158	1	138	0.692	Homogeneous

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The homogeneity test shows that the data variance is homogeneous, meaning that the data distribution between the pretest and posttest does not show a significant difference in variance. Based on the test results, the significance value obtained based on the Mean is 0.692. This value is greater than 0.05, so it can be concluded that the data groups have the same or homogeneous variance. This homogeneity condition ensures that the diversity of data in the sample is stable and will not interfere with the results of the comparison test in the next stage [20]. Fulfilling all prerequisite assumptions (normality and homogeneity) brings researchers to the core testing stage, namely the significant difference test using the Paired Sample T Test.

Table 5. Paired Sample T-Test

Variables	Mean Difference	T	df	Sig. (2-tailed)
Pre-test - Post Test	-10.971	-41.725	69	0.0000

The results of the paired sample t-test showed a t-value of -41.725 with a significance value of 0.000 ($p < 0.05$), which means there is a significant difference between students' pretest and posttest scores. The average difference between pretest and posttest scores of 10.971 indicates a significant increase in learning outcomes after using digital Flipbook learning media.

The very small significance value indicates that the increase in learning outcomes did not occur by chance, but rather was a real impact of the treatment given. Thus, the alternative hypothesis stating that the use of digital Flipbook learning media has an effect on student learning outcomes is accepted, while the null hypothesis is rejected. These findings indicate that digital Flipbook media can be used as an effective and innovative learning medium in improving students' conceptual understanding and abilities in engineering drawing subjects [21]. Although there is a statistically significant difference, additional analysis is needed to measure the level of effectiveness of this increase through N-Gain calculations.

Table 6. N-Gain Score Test

Variables	N	Min	Max	Mean	Std. Dev
N-Gain Score	70	0.03	1.0	0.5611	0.11258

The Normalized Gain (N-Gain) calculation is an important instrument in this study to measure the effectiveness of using Flipbook digital learning media in improving students' cognitive achievement. Based on the data tabulation, the average N-Gain score is 0.5611. Referring to the N-Gain classification criteria, this score places the learning effectiveness in the "moderate" category. This distribution of effectiveness is reinforced by the range of students' N-Gain scores, which range from a minimum of 0.03 to a maximum of 1.0. The

maximum N-Gain value of 1.0 is still within the theoretical limit, so there is no error in the data calculation.

The significance of this N-Gain increase is inseparable from the quality of the data distribution used in the analysis. As explained in the normality test, this research data has a strong statistical basis because both pre-test and post-test instruments have significance values of 0.052 and 0.095, respectively. Because these values are above the 0.05 threshold, the data is normally distributed. This validity is further confirmed through a homogeneity test, where the significance value based on the Mean of 0.692 indicates that the data variance is homogeneous.

This N-Gain analysis essentially shows a cognitive leap from the initial pre-test average score of 79.91 to the post-test average score of 90.89. The consistency of this improvement was validated through a paired-sample t-test, which showed that the mean difference between the two tests had a significance level of 0.000. These results prove that the flipbook media intervention statistically had a significant impact on student learning outcomes.

Pedagogically, the success of the improvement in this media category shows that Digital Flipbook media can be a catalyst in simplifying complex engineering drawing materials [22]. The integration of multimedia elements in it has been proven effective in minimizing students' cognitive load, as evidenced by a fairly strong positive correlation of 0.564 between the pre-test and post-test variables so that the use of this media not only meets the quantitative completion criteria but also provides a substantial contribution to supporting a more innovative and student-oriented digital learning transformation in the Independent Curriculum era.

Furthermore, the analysis of the increase in the mean score from 79.91 to 90.89 reflects a significant change in the way students process abstract technical information. Engineering drawings, as the language of industrial communication, demand high visual accuracy and a high level of understanding of standard symbols. The use of flipbooks, the digital media used in this experiment, had a significant impact because it presented more concrete visualizations than static printed text books [23]. Students' ability to interpret working drawings improved because this media allows for a dynamic and systematic presentation of materials such as line types, sizing rules, and projections. This suggests that digital media intervention is crucial in subjects that rely on visual-spatial aspects [24].

The effect of this experiment is also seen in the inclusiveness aspect of learning outcomes. The relatively small standard deviation of the post-test results (2.429) indicates that the use of digital flipbook media was able to provide an even impact on all research subjects, namely 70 10th-grade students majoring in Welding Engineering. This media is effective in bridging the gap in students' initial abilities, where students with low initial abilities can be assisted through interactive features that support independent learning.

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Statistically, the t-value of -41.725 with a significance of 0.000 confirms that the treatment using flipbooks provides a consistent real impact, not just a chance factor.

Furthermore, its effectiveness, which falls into the "moderate" category with an N-Gain of 0.5611, indicates that this medium has sufficient room for deeper integration into the vocational education curriculum. In the context of vocational schools, optimal learning outcomes are measured not only by numbers but also by students' cognitive readiness to apply concepts to practical activities. In the flipbook workshop in this study, digital learning was proven to improve cognitive achievement by simplifying material that was initially considered difficult to make it more interesting and easier to understand.

The success of this experiment also strengthens the Cognitive Multimedia Learning theory which states that learning is more effective if the material is presented through the right combination of text and visuals [25]. With the availability of technical illustrations, animations, and explanatory videos in flipbooks, students can build a deeper conceptual understanding without feeling bored. This transformation is very relevant to the needs of today's vocational education, which demands graduates to adapt to industrial technology. Overall, this experiment shows that the strategic integration of Digital flipbook media can significantly improve the quality of the learning process and student learning outcomes in technical drawing competencies.

4. CONCLUSION

Based on the research results, it can be concluded that the use of digital flipbook learning media has a significant impact on improving student learning outcomes in the Technical Drawing subject at vocational schools. This is indicated by an increase in the average score from 79.91 to 90.89 and the results of the paired t-test which showed a significance value of 0.000 ($p < 0.05$).

Furthermore, the N-Gain analysis results of 0.5611 indicate that learning effectiveness is in the moderate category. This finding indicates that digital flipbook media can quite effectively improve students' conceptual understanding, particularly in visual and abstract material.

This study has limitations in the use of a pre-experimental design without a control group, so that the results obtained cannot yet be fully generalized causally.Nevertheless, the significant improvement results still provide an early indication of the effectiveness of the media used.In addition, the research only focused on cognitive aspects without considering other factors such as learning motivation and psychomotor skills.Therefore, further research is recommended to use a stronger experimental design and examine additional variables to obtain more comprehensive results.

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