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ORIGINAL

# An Analysis of The Effectiveness of Digital Authentic Assessment Integrated With Virtual Reality in Electrical Power Distribution Courses

## Análisis de Viabilidad de la Evaluación Auténtica Digital Integrada con Realidad Virtual en Cursos de Distribución de Energía Eléctrica

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## ABSTRACT

Vocational education plays a crucial role in enhancing the quality of Human Resources (HR). However, based on a needs analysis, 82 % of students reported not understanding what had been taught, indicating a gap between classroom learning and the assessment process. This study used a development method with a mixed-methods approach, combining qualitative and quantitative data, following the Borg and Gall model through six stages: research and information collecting, planning, developing a preliminary product, preliminary field testing, main product revision, and main field testing. The resulting product, a Digital Authentic Assessment assisted by Virtual Reality (VR), was validated as "Valid" by experts and rated as "Very Practical" by both lecturers and students. To measure effectiveness, a t-test was conducted comparing the learning outcomes of experimental and control classes, with results showing a significant improvement in the experimental group. The study concludes that the Digital Authentic Assessment with VR is valid, practical, and effective for the Electric Power Distribution course in vocational education.

**Keywords:** Vocational Education; Digital; Authentic Assessment; Virtual Reality (VR); Electric Power Distribution.

## RESUMEN

La formación profesional desempeña un papel fundamental en la mejora de la calidad de los recursos humanos (RH). Sin embargo, según un análisis de necesidades, el 82 % de los estudiantes afirmaron no comprender lo que se les había enseñado, lo que indica una brecha entre el aprendizaje en el aula y el proceso de evaluación. Este estudio utilizó un método de desarrollo con un enfoque mixto, combinando datos cualitativos y cuantitativos, siguiendo el modelo de Borg y Gall a través de seis etapas: investigación y recopilación de información, planificación, desarrollo de un producto preliminar, pruebas preliminares sobre el terreno, revisión del producto principal y pruebas principales sobre el terreno. El producto resultante, una evaluación auténtica digital asistida por realidad virtual (RV), fue validado como «válido» por expertos y calificado como «muy práctico» tanto por profesores como por estudiantes. Para medir la eficacia, se realizó una prueba t comparando los resultados del aprendizaje de las clases experimentales y de control, y los resultados mostraron una mejora significativa en el grupo experimental. El estudio concluye que la evaluación auténtica digital con RV es válida, práctica y eficaz para el curso de distribución de energía

eléctrica en la formación profesional.

**Palabras clave:** Formación Profesional; Digital; Evaluación Auténtica; Realidad Virtual (RV); Distribución de Energía Eléctrica.

## INTRODUCTION

Education plays an important role in preparing the next generation of the nation, as they are the future leaders, workers, and drivers of the economy. Education must be able to strengthen the identity of the Indonesian nation in society.[1,2,3] Under any circumstances, the Indonesian Nation still appears as a nation with all its personality.[4,5,6] The resilience of a nation's identity is not formed in a short time, but takes a long time.[7,8] The formation of a nation's identity begins with the development of good spiritual mentality, attitudes, and exemplary personality, as well as a high level of intelligence.[9,10] From some of the above definitions, it can be said that education is a central factor in efforts to develop the quality of a nation.[11,12,13] In this case, the Indonesian government seeks to improve the quality of human resources by organising national education that can function to develop the ability and shape the character and civilisation of a dignified nation in order to educate the nation's life.[7,14]

Efforts to improve the quality of human resources through education and training are a priority that must continue to be carried out by the Indonesian people with reference to the demands of the labour market, both on a local, national, regional and international scale.[15] The competitiveness of Indonesian industry at the global level is highly dependent on the quality of its human resource.[15] If the quality of human resources is low, the competitiveness of the industry is low and vice versa if the quality of human resources is high, the competitiveness of the industry is also high.[16] High quality human resources can only be produced from the education process which must also be of high quality. Therefore, the learning and assessment process must be carried out as well as possible through careful planning.[17,18] This aims to produce quality graduates who are ready to compete in the world of work, including the learning and assessment process of vocational education.[7,8]

In accordance with the characteristics of vocational learning, namely competency-based learning, the type of assessment that is widely applied is authentic assessment.[19] Authentic assessment is a significant and real measurement of learner learning outcomes for the domains of attitude, skills and knowledge.[20] Authentic assessment encourages learners to observe, reason, try, build networks, and others.[21] In conducting authentic assessment, the stages that educators need to do are: construct, organise, analyse, synthesise, interpret, explain, evaluate, create.[22] The phenomenon that occurs in almost every lesson is that the achievement of learning outcomes is always measured by a final test in the form of an essay or multiple choice.[19] This strategy is no longer suitable at this time because it requires students to focus on memorisation. Creativity and thinking ability of students are not stimulated properly.[23,24]

Authentic assessment is regulated in government concerning the assessment of learning outcomes by educators in primary and secondary education which explains that authentic assessment is the main approach in assessing learning outcomes by educators.[25] Authentic assessment uses real-world events as concepts in the learning process. Authentic assessment is used to comprehensively assess the input, process, and outcome of learning.[24,26]

The Electric Power Distribution course is the main course in DIII Electrical Engineering, Faculty of Engineering, Padang State University, DIII Electrical Engineering students are required to take and follow the Electric Power Distribution lecture. The output of this learning process is that students are expected to be able to have knowledge and expertise in the field of electrical power distribution starting from the planning, preparation, implementation, testing to continuous control. Understanding and knowledge of electrical power distribution is very useful for DIII Electrical Engineering students, Department of Electrical Engineering, FT-UNP because in the world of education and work today there are many plants and distribution networks for public use and electrical engineering graduates will not be separated from the distribution of electricity.

Nowadays, electricity is not only a monopolised need in urban areas, but also an urgent need in remote village.[27] Seeing the importance of this need for electricity, it is necessary to equalise the use of electrical energy in urban and rural areas through increased development of distribution networks.[28] The available electric power must fulfil the needs of customers well, meaning that the electric power system must be safe and reliable to use. This needs to be a priority because of the importance of electrical energy for people's lives and national development.[29] This condition is in line with the statement which reveals that in planning the distribution system must meet a number of objectives in accordance with the economic interests and quality of electricity supply.[30] In fact, educators have not used authentic assessment techniques that directly involve the cognitive, affective and psychomotor domains to assess students' knowledge, so it needs integration with technology.[31]

Digital Authentic Assessment powered by Virtual Reality (VR) is a powerful educational tool to improve learner skills and learning outcomes.[31] Virtual Reality (VR) technology, when integrated into authentic assessment, offers a new approach to promoting literacy among learners in both theory and practical learning environments.[32] The use of Virtual Reality (VR) in education provides an immersive and interactive experience, creating a lifelike virtual environment that stimulates interest and supports the development of interests among students.[33] In addition, VR has been developed to train learners in identifying hazards present in laboratories during theory and practical learning.[34] Overall, the combination of Authentic Assessment and VR technology presents a promising avenue to enhance students' learning experience and achieve educational goals.[35,36,37]

Managing authentic assessment for classes with a large number of learners can be very difficult and requires specialised strategies to ensure every student gets a fair and in-depth assessment.[38] This is the main reason for implementing authentic assessment using virtual reality (VR), which takes longer than traditional assessment because it involves direct observation and detailed feedback.[35,36] Therefore, Authentic Assessment assisted by Virtual Reality (VR) is important to be applied to the learning of electrical power distribution practices, because with the help of Virtual Reality (VR) can attract students' interest in learning by presenting interesting features in the Virtual Reality (VR) application and can train students' performance in practice, improve inquiry abilities, skills and work habits through real tasks. Learners are expected to actively think, reason, communicate their knowledge and solve realistic problems.

## METHOD

This research method is development research with qualitative and quantitative approaches or commonly known as mixmethod.[39] The development model applied follows the Borg and gall research and development model, with 6 steps including Research and information collecting, Planning, Develop preliminary form of product, Preliminary field testing, Main product revision and Main field testing. The questionnaire data was analysed using quantitative descriptive techniques to measure the effectiveness and practicality of the product.

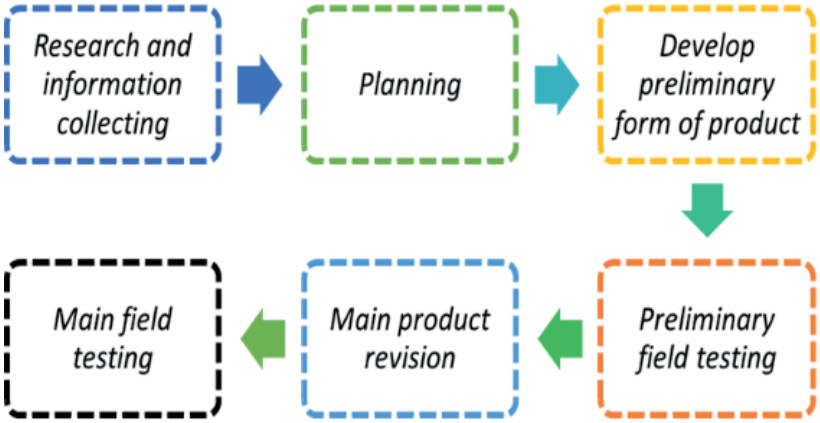


**Figure 1.** Development Steps of the Borg and Gall Model

The effectiveness analysis is seen from the results of the T-test, which before conducting the T-test and N-gain Score must go through the prerequisite test. Prerequisite tests used Normality and homogeneity. The test instrument used has been tested for feasibility to be used as a test instrument. Data analysis with the t test in the development of Digital Authentic Assessment assisted by Virtual Reality (VR) in this Distribution course was carried out using the help of SPSS version 22. To make a decision whether the difference is significant or not, the t-count price is compared with the t-table with dk (n1 + n2)-2 with a significant level of 0,05. Small-scale and large-scale effectiveness testing is done by comparing learning outcomes before and before and after treatment by using Pretest-Posttest Control Group Design. In this research design using two sample groups, namely the control group and the experimental groupcontrol and experimental groups. The data analysis was conducted with the assistance of SPSS software to ensure accurate results

## RESULTS

### Small-Scale Effectiveness Test

Before the effectiveness test, a prerequisite test was carried out, namely homogeneity and normality. The normality test results for the small class trial indicate that the data are normally distributed. The significance values from the posttest are greater than the 0,05 significance level, showing that both the pretest and posttest data satisfy the normality assumption. The results of the homogeneity test that has been carried out state the same thing where the Sig. value at pretest and posttest is greater than 0,05, which means homogeneous.

**Table 1.** Small-scale T-test

| Independent Samples Test Pretest | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95 % Confidence Interval of the Difference | |
| | | | | | | | | | Lower | Upper |
| Nilai | Equal variances assumed | ,400 | ,532 | ,146 | 28 | ,885 | ,20000 | 1,36696 | -2,60008 | 3,00008 |
| | Equal variances not assumed | | | ,146 | 27,951 | ,885 | ,20000 | 1,36696 | -2,60030 | 3,00030 |

The results of the analysis conducted on the small class to compare the results of the pretest and posttest. The significance value (Sig. 2-tailed) of 0,885 indicates that the statistical test results are significant at the 95 % confidence level (α = 0,05). Thus, it can be concluded that there is a significant difference between the pretest and posttest results, which shows the effectiveness of the treatment in improving the learning outcomes of students in small classes.

**N-Gain Score**

The N-Gain value obtained after the analysis is 0,96, so that the learning outcomes after the application of digital authentic assessment assisted by virtual reality (VR) (small class) are in moderate criteria. The results of this analysis interpreted with the N-Gain table can be concluded that digital authentic assessment assisted by virtual reality (VR) is effective in improving learning outcomes. The criterion for the level of effectiveness is at a moderate level.

**Large-Scale Effectiveness Test**

Before conducting the effectiveness test, prerequisite tests were performed, namely the homogeneity and normality tests. The results of the normality test in the large class trial indicate that the data are normally distributed. The posttest significance values exceed the 0,05 threshold, showing that both the pretest and posttest data meet the normality assumption. Similarly, the homogeneity test results reveal that the significance values for both the pretest and posttest are greater than 0,05, indicating that the data are homogeneous.

**Table 2.** Large-scale T-test

| Independent Samples Test Pretest | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95 % Confidence Interval of the Difference | |
| | | | | | | | | | Lower | Upper |
| Nilai | Equal variances assumed | ,664 | ,418 | ,144 | 58 | ,886 | ,13333 | ,92666 | -1,72158 | 1,98824 |
| | Equal variances not assumed | | | ,144 | 56,650 | ,886 | ,13333 | ,92666 | -1,72252 | 1,98919 |

The results of the analysis conducted on the Large class to compare the results of the pretest and posttest. The significance value (Sig. 2-tailed) of 0,886 indicates that the statistical test results are significant at the 95 % confidence level (α = 0,05). Thus, it can be concluded that there is a significant difference between the pretest and posttest results, which shows the effectiveness of the treatment in improving the learning outcomes of students in Lareg classes.

The boxplot presented above illustrates the mean difference and the 95 % confidence intervals for the pretest data under two assumptions: equal variances assumed and equal variances not assumed. The boxes represent the interquartile range (IQR), with the central line indicating the median value. The whiskers extend to the minimum and maximum values, while the error bars represent the 95 % confidence intervals, showing the range within which the true mean difference is expected to lie. Both groups display similar central tendencies, with the mean difference close to zero and overlapping confidence intervals. This overlap suggests no significant difference between the two groups, as the confidence intervals include the value of zero. This further supports

the conclusion that, under both assumptions, the observed differences between the groups are not statistically significant.

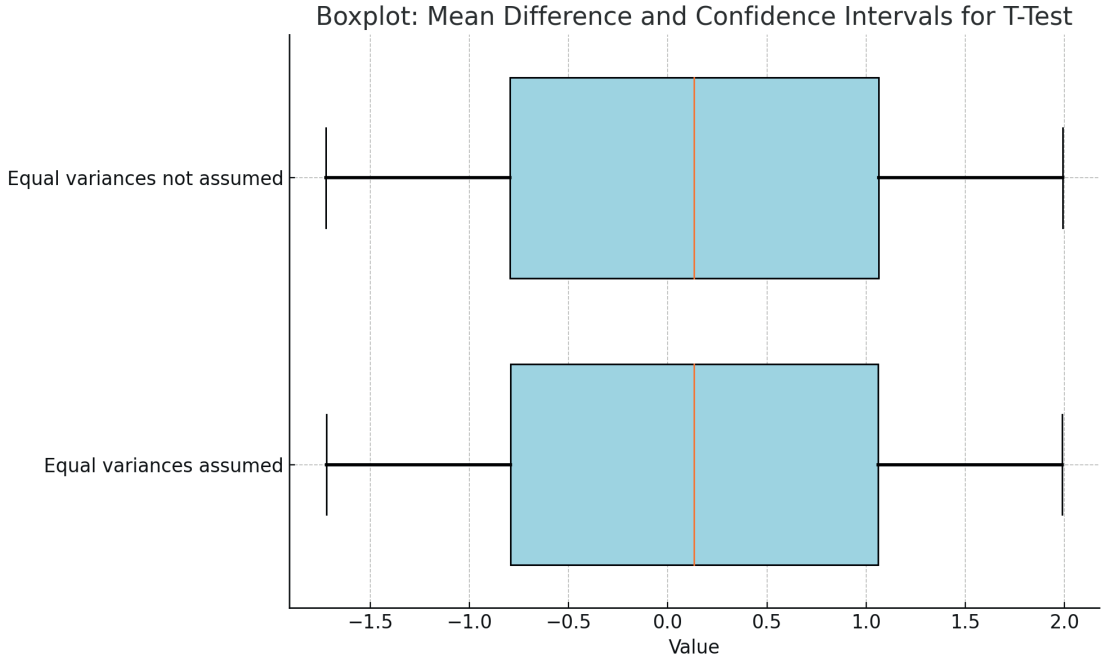


**Figure 1.** Mean Difference and Confidence Intervals for T-Test

## DISCUSSION

Research using Digital Authentic Assement products assisted by virtual reality (VR) has been carried out and produces research products in the form of applications that are ready for students to use during learning, lecturer guides, student guides, teaching material books and research instruments. The product quality criteria consist of validity, practicality and effectiveness, the three criteria are measured from the ideal aspects of the product that has been developed, then formulated with assessment instruments (validity, practicality, and effectiveness), carried out through three stages, namely individual trials, group trials and field tests. So, the development of Digital Authentic Assement assisted by virtual reality (VR) is in the category of valid, practical, effective because it was developed based on three criteria and three stages identified by experts.

Research on the development of an authentic assessment model integrated with virtual reality (VR) showed significant results through a t-test, indicating a positive influence on the effectiveness of the assessment. These results are in line with previous research conducted by Smith (2021), who found that the use of VR in education can increase student engagement and understanding of complex concepts. By utilising VR technology, students can experience a real simulation of the situation they are studying, thus improving their memory and understanding of the electrical power distribution material. Students learn better when they are actively involved in the learning process. Research [40] shows that VR-based learning can increase student motivation and participation, which contributes to better learning outcomes. By integrating authentic assessment in a VR context, students are not only tested This research method is development research with qualitative and quantitative approaches or commonly known as mixmethodon theoretical knowledge, but also on their practical abilities in situations similar to the real world.[41]

Highlighted the importance of rapid and interactive feedback in technology-based learning. In the context of digital authentic assessment integrated with VR, students can receive immediate feedback on their performance, allowing them to make improvements in real-time. This not only increases the effectiveness of the assessment, but also helps students to better understand the material being taught. Thus, the results of this study show that the development of an authentic assessment model integrated with VR is not only effective, but also relevant to the latest developments in educational theory and practice.

Additionally, while the results from the small-scale and large-scale effectiveness tests were promising, further improvements in the design and implementation of VR-based simulations are necessary to maximize their potential. Research by Witten suggests that continuous refinement of educational technologies is crucial to ensuring their effectiveness in different learning contexts. In particular, the VR simulations could be enhanced by incorporating more complex scenarios and interactive features that better replicate the challenges faced in the real-world electrical power distribution industry.

Finally, the integration of VR into authentic assessment also poses challenges in terms of cost, accessibility,

and technical support. While VR technology has the potential to revolutionize vocational education, its widespread adoption requires overcoming barriers related to infrastructure and resources. The Indonesian government and educational institutions need to invest in the necessary infrastructure, including hardware and software, to ensure that VR-assisted learning tools are accessible to all students. This is in line with the findings of Raslan and Forawi (2024), who emphasized the importance of addressing technological disparities in education to ensure equitable access to innovative learning tools.

The development of Digital Authentic Assessment integrated with Virtual Reality (VR) for vocational education, particularly in Electrical Power Distribution courses, represents a promising advancement in the field of education. The study's results suggest that this approach is not only effective in improving learning outcomes but also aligns well with the demands of the modern workforce. However, further research is needed to refine the technology and address the logistical challenges associated with its implementation to ensure its widespread adoption and success in enhancing vocational education.

## CONCLUSIONS

This study demonstrates that VR-assisted Digital Authentic Assessment is an effective learning innovation in vocational education, particularly for understanding complex electrical engineering concepts. The effectiveness testing showed no statistically significant difference between pretest and posttest results, with a Sig. (2-tailed) value of 0,885 in the small-scale trial and 0,886 in the large-scale trial. However, the N-Gain value of 0,96 in the small-scale trial indicates a significant improvement in learning outcomes. The VR simulations enhance students' conceptual understanding and practical skills by providing interactive and realistic visualizations of the electrical power distribution system. While this technology is promising for vocational education, particularly in aligning students' skills with industry standards, there are limitations, including sample size and the short-term use of the product. Future research should include larger, diverse samples and longer implementation periods to assess long-term effectiveness and knowledge retention. Improvements in design, implementation, and evaluation could expand the adoption of this innovative assessment approach to improve the quality of engineering and technology education in Indonesia.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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