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Developing Digital Competence Through Total Station and Laser Waterpass Training for Teachers and Students of SMKN 1 Bukittinggi

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ABSTRACT

Modern surveying technologies, including Total Station and Laser Waterpass, are essential in construction and surveying activities. However, SMKN 1 Bukittinggi still faces limited access to digital surveying instruments and limited structured training. This community service program aimed to improve the competence of teachers and students in operating digital measuring instruments through theoretical instruction, simulation, field practice, data analysis, and pretest-posttest evaluation. The implementation stages included coordination with the partner school, preparation of training modules, introduction to instrument principles, hands-on measurement activities, processing of field data using GIS and AutoCAD Civil 3D, mentoring, and program evaluation. The results showed an improvement in participants' conceptual understanding and practical skills. The post-training competency completion rate reached 32%, indicating that the training had a positive effect on participants' digital competence, although additional practice and continuous mentoring are still needed. The program also produced training materials and documentation that can support future learning at the school.

Keywords: *Digital Competence; Total Station; Laser Waterpass; Vocational School; Surveying Training.*

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INTRODUCTION

Vocational education must adapt to digital transformation and the needs of Industry 4.0 [1], [2]. In construction and surveying, high-precision measurement competence using modern instruments, especially Total Station and Laser Waterpass, is important for ensuring the quality of planning and project implementation [3], [4]. Mastery of instrumentation, calibration procedures, and the workflow of data acquisition, validation, and processing is a basic requirement for graduates who need to work effectively in an increasingly digital work environment [5].

SMKN 1 Bukittinggi, through its Geomatics Engineering expertise program, has strong potential to produce work-ready graduates. However, practical learning is still dominated by conventional methods and limited access to digital surveying instruments. This gap in facilities and the lack of specific training cause uneven understanding among teachers and students regarding basic leveling concepts, angle-distance measurement, and data transfer procedures [6], [7], [8]. This condition reduces students' exposure to current industrial practice standards [9].

The urgency of learning intervention lies in the need to strengthen teachers' instructional

capacity and provide students with authentic field practice [10]. This training program was designed in line with the Merdeka Belajar Kampus Merdeka (MBKM) policy and the achievement of vocational education Key Performance Indicators (IKU). It placed technology-based skills as the main outcome of the program [11]. Through a structured approach, the training targeted improvements in instrument literacy, occupational safety, and the quality standards of field measurement [12], [13].

Specifically, this activity aimed to: (1) improve conceptual knowledge of the working principles of Total Station and Laser Waterpass; (2) train operational skills, including instrument setup, alignment, calibration, sighting, and data recording; (3) equip participants with the ability to process and interpret data using mapping software such as GIS and AutoCAD Civil 3D; and (4) evaluate learning outcomes using a pretest-posttest design. The initial implementation showed a post-training completion rate of 32%, which reflects an increase in competence but also indicates the need for continuous strengthening.

The main contribution of this article is the presentation of an integrated training model that combines theoretical instruction, field practice, data processing, and mentoring. This model is operational and replicable for vocational school contexts. The novelty of the approach lies in its emphasis on the full cycle from data acquisition to data interpretation, supported by a sustainability strategy that involves teachers as trainers and integrates the training material into the school curriculum [14]. The findings and implementation reflections are expected to become a reference for similar programs that aim to strengthen digital mapping competence in vocational education [15].

METHOD

The community service program, entitled “Digital Competence Development: Total Station and Laser Waterpass Training for Teachers and Students of SMKN 1 Bukittinggi”, was implemented through several systematic stages. Each stage was designed to ensure that the training ran effectively and provided practical benefits for the participants.

Preparation Stage

The preparation stage included initial planning and coordination before the field training activities. The activities consisted of:

- Coordinating with the principal and teachers of SMKN 1 Bukittinggi to determine the schedule and technical implementation of the training.
- Surveying the training location to determine instrument setup points and field practice areas.
- Preparing training materials, including learning modules and tutorials for using Total Station and Laser Waterpass.
- Providing equipment, including Total Station, Laser Waterpass, tripods, prisms, and data processing software.

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Figure 1: Coordination with the partner school.

Implementation Stage

The training implementation consisted of theoretical instruction, simulation, field practice, and data analysis. These activities were designed to improve participants' ability to operate digital measuring instruments and process the resulting data.

Theoretical Training Session

- Introduction to Total Station and Laser Waterpass, including their working principles, components, and functions.
- Measurement methods, including data collection techniques and calibration procedures before instrument use.
- Use of digital mapping software, including GIS and AutoCAD Civil 3D, for processing survey data.

Figure 2: Training session on Total Station and Laser Waterpass materials.

Simulation and Field Practice

- Instrument installation and position adjustment using leveling principles and plumb bob alignment.

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- Measurement of angles, distances, and elevations using Total Station and Laser Waterpass.
- Recording of measurement data and field verification of measurement accuracy.

Figure 3: Field practice activities.

Data Analysis and Measurement Processing

- Processing of measurement data using GIS and AutoCAD Civil 3D.
- Conversion of measurement data into digital map formats and elevation contour models.
- Interpretation of measurement results to support applications in construction projects.

Figure 4: Field data processing and technical analysis.

Program Evaluation Stage

The evaluation stage included direct skill testing in the field, analysis of measurement results, and assessment of participants' ability to prepare survey reports. A satisfaction survey was also conducted with participants and the partner school to measure the effectiveness of the training

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and identify aspects that need improvement. The evaluation results were used as a basis for improving future training methods.

For sustainability, the program was designed so that trained teachers could act as trainers for the next group of students. This strategy allows the acquired skills to continue being applied and developed at SMKN 1 Bukittinggi. In addition, the training module and video documentation can serve as learning materials for other schools that want to apply a similar method. Participants' understanding was evaluated using pretest and posttest questions in multiple-choice format.

RESULTS AND DISCUSSION

The evaluation results showed an increase in participants' competence after the training. The comparison between pretest and posttest scores indicated a shift in conceptual and procedural understanding related to the operation of Total Station and Laser Waterpass. Using a 15-item multiple-choice test instrument, the post-training competency completion rate reached 32%. This result indicates that some participants met the minimum competency standard and were able to apply basic measurement procedures with greater confidence.

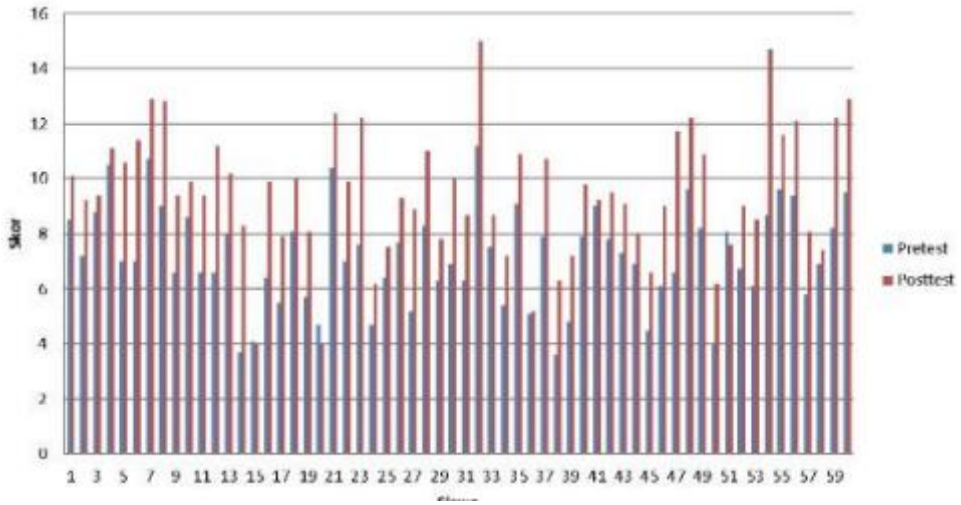

Figure 5: Comparison of students' pretest and posttest scores.

In terms of score distribution, posttest scores tended to shift toward higher values compared with pretest scores. This shift was reflected in the increased proportion of correct answers on items that tested instrument setup, alignment, sighting, and data recording procedures. However, differences in achievement among participants were still visible. Some participants progressed quickly, while others required more intensive assistance. This finding indicates the need to strengthen differentiated learning strategies during practical sessions.

CONCLUSION

The Total Station and Laser Waterpass training improved the digital competence of teachers and students at SMKN 1 Bukittinggi. The evaluation results showed an increase in understanding, with a competency completion rate of 32%. The training program supports MBKM and IKU policies through the improvement of vocational graduate quality. Program sustainability can be achieved by involving trained teachers as trainers for the next generation of students and by integrating the training materials into the school curriculum.

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