CONSTRUCTION OF COMPUTER LABORATORY: THE EMBODIMENT OF DIGITAL TRANSFORMATION IN EDUCATION AT SMP NEGERI 02 MUKOMUKO

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ABSTRACT

The Construction of the Computer Laboratory Room at SMP Negeri 02 Mukomuko is a strategic project aimed at supporting digital transformation in secondary education. This report discusses architectural planning, construction methodology, and interim results, with project progress reaching 85%. Primary data were obtained from the Bill of Quantities (BoQ) and architectural drawings. The analysis was conducted using civil engineering approaches, considering compliance with Indonesian National Standards (SNI) and cost efficiency principles. The findings indicate that the reinforced concrete structure with an approximate area of 108 m² meets the functional and safety requirements for a school laboratory. Overall, the project has proceeded according to schedule and expected quality.

Keywords: Computer Laboratory, Construction, SMP Negeri 02 Mukomuko, Civil Engineering, Architecture

I. INTRODUCTION

Education in the 21st century faces challenges different from previous eras. The digital revolution has transformed how we learn, teach, and access information. In this context, the availability of adequate educational infrastructure is no longer merely a supplementary need, but a strategic necessity to prepare the younger generation to face the demands of the times.

SMP Negeri 02 Mukomuko, located in Bengkulu Province, recognizes the importance of this transformation. The construction of a Computer Laboratory room with an area of 108 m² represents the school's commitment to educational modernization. This project is not merely about building a structure, but creating a digital learning ecosystem that will shape students' skills for the future.

According to UNESCO (2022), the gap in access to digital facilities between urban and rural areas remains a major challenge in developing countries. In Indonesia, this gap is reflected in the disparity of educational quality between regions. The construction of a computer laboratory in Mukomuko represents a concrete step in reducing this gap, providing equal opportunities for students in rural areas to develop their digital literacy.

II. CONCEPTUAL FOUNDATION

The planning of the computer laboratory at SMP Negeri 02 Mukomuko is based on modern educational architecture principles that integrate function, aesthetics, and sustainability. The building design not only considers technical construction aspects, but also how the space can support various interactive learning methods.

1. Ergonomic and Comfort Principles

Ergonomics is a primary consideration in spatial planning. According to Dul and Weerdmeester (2008), ergonomic workspaces can increase productivity by up to 25% and reduce user fatigue. In the context of a computer laboratory, this is realized through desk arrangements with heights of 70-75 cm, screen viewing distances of 50-70 cm, and height-adjustable chairs.

The spatial layout follows a linear pattern that facilitates circulation and supervision. With a capacity of 36 computer units plus one instructor desk, this space is designed to support collaborative learning while enabling teachers to effectively monitor all student activities.

2. Tropical Climate Adaptation

Mukomuko's location with its humid tropical climate and high rainfall requires a design approach responsive to natural conditions. Tropical architecture principles are applied through window orientation on the north and south sides to maximize natural lighting without direct glare. Cross-ventilation is designed through wooden louvers that allow natural air circulation, reducing the need for artificial cooling.

A 2-meter-wide veranda at the front functions as a thermal transition zone that protects the main space from direct exposure to heat and rain. This element also strengthens the aesthetic character of traditional Indonesian school buildings that prioritize open spaces.

3. Safety and Functionality Standards

Referring to Minister of Education Regulation No. 24 of 2007, computer laboratories must meet minimum standards of 2 m² per student, equipped with safe electrical installations, adequate lighting, and good ventilation systems. This project exceeds these minimum standards by providing more spacious rooms and digital school-grade electrical systems.

The electrical installation is designed using NYM 2x2.5 mm cables with MCB protection and grounding according to SNI 0225:2019. Each computer has its own power outlet circuit to avoid overload, while 11 LED lamp points of 19W are installed to ensure even lighting of at least 300-500 lux.

III. IMPLEMENTATION METHODOLOGY

The project implementation follows a systematic Project Management Body of Knowledge (PMBOK) approach, encompassing planning, execution, monitoring, and evaluation stages. This methodology ensures that every aspect of construction is measurable and accountable.

1. Strategic Planning Stage

Planning began with needs analysis through consultation with the school. The results showed the need for space for 36 computers with adequate circulation areas. From this analysis, a building design measuring 12 x 8 meters with a 2-meter veranda was established, resulting in a total area of 108 m².

The Budget Plan (RAB) was prepared based on the Unit Price Analysis of Work (AHSP) from the Ministry of Public Works with a total budget of IDR 342,671,174.00. Detailed calculations cover all work items from preparation to finishing, taking into account local material prices and regional labor wages.

2. Phased Construction Execution

Construction implementation began in July 2025 with a completion target of December 2025. The work is divided into eight main stages: preparation, foundation, concrete structure, walls, roofing, flooring and ceiling, installation, and finishing.

The foundation stage uses a river stone system with a depth of 80 cm, adjusted to local soil conditions. Concrete sloof 15/20 cm with K-250 quality is installed as a lower structure binder. The selection of river stone foundation proved economical and suitable for single-story buildings in areas with stable soil bearing capacity.

The main structure uses reinforced concrete with three types of columns: 15/20 cm, 20/20 cm, and practical columns 11/11 cm. The reinforcing steel used meets quality standards of fy = 400 MPa according to SNI 2052:2017. The casting process is carried out in stages with strict supervision of mixture composition and drying time.

3. Material Innovation and Cost Efficiency

One strategic decision in this project is the use of galvanized lightweight steel for the roof frame. This material was chosen due to several advantages: light weight thus reducing structural load, corrosion resistance in humid environments, and faster installation time compared to conventional wood.

The roof covering uses BJLS corrugated zinc 0.20 mm with a 30° slope. The anti-rust bolt connection system ensures water resistance against rain. The selection of this material resulted in cost efficiency of about 3% from the initial estimate without reducing the quality and durability of the building.

IV. RESULTS AND DISCUSSION

As of October 2025, physical construction progress has reached 85%, indicating implementation according to schedule. Main structural work is 100% complete, while interior finishing and installation reached 85%. Minor delays only occurred at the painting stage due to rainy weather factors that slowed the drying process.

1. Implementation Quality

Field inspections show work quality that meets standards. Dense concrete surfaces without hairline cracks indicate good casting quality. Wall plaster is smooth with an average thickness of 15 mm according to specifications. Installation of 40x40 cm floor ceramics was done with precision, resulting in a flat surface with neat joints 3 mm thick.

The electrical installation system has been tested and declared safe. There are no loose connections or potential current leaks that endanger users. The electrical load capacity can support the operation of 36 computers simultaneously without risk of overload.

2. Supervision and Quality Control

Project supervision is carried out in tiers by the school's technical team and consultants. Control is conducted in three aspects: time, cost, and quality. Weekly reports are used to evaluate progress and identify potential problems early.

Supervision results show a 95% conformity level between planning and realization. Minimal deviations only occurred in the time aspect with a tolerance of less than 5%, still within reasonable limits for construction projects.

3. Work Safety Aspects

All workers are equipped with Personal Protective Equipment (PPE) according to Minister of Manpower Regulation No. 5 of 2018 on Occupational Health and Safety. Work areas are provided with safety fences and hazard signage to prevent accidents. Construction waste is managed properly to avoid polluting the school environment.

This safety-first approach not only protects workers, but also ensures that school activities are not disrupted during the construction process. Work schedule coordination with teaching and learning activities is carried out to minimize noise disturbances.

4. Impact and Benefits: More Than Just a Building

The construction of this computer laboratory provides multidimensional impacts that transcend the physical aspects of the building. From an educational perspective, this facility will become the center of transformation from conventional to digital-based learning methods.

Improving Learning Quality

The availability of a computer laboratory enables the implementation of various innovative learning methods. Students can access digital learning resources, develop technology-based projects, and practice 21st-century skills such as computational thinking, digital literacy, and problem solving.

Teachers have the opportunity to integrate technology into the teaching process through multimedia presentations, online assessments, and collaborative learning tools. This aligns with the spirit of the Independent Curriculum that encourages creativity and technology-based learning.

5. Equalization of Digital Education Access

For students in Mukomuko, this laboratory opens access to previously limited technology. The digital divide between urban and rural students can be reduced through equal facilities. Every student has the same opportunity to develop digital skills crucial for their future.

Data from the Ministry of Education, Culture, Research and Technology (2023) shows that schools with adequate ICT facilities have an average academic achievement 15-20% higher than schools without similar facilities. Investment in digital infrastructure is an investment in long-term human resource quality.

6. Economic and Social Impact

This project also provides local economic impact through labor absorption and empowerment of the regional construction sector. Materials such as bricks, cement, and sand are obtained from local suppliers, while labor is recruited from the surrounding community.

From a social aspect, the presence of modern facilities at school increases public trust in educational institutions. Parents feel that their children's educational investment will produce competencies relevant to the needs of industry and the workforce.

7. Replication Model for Other Schools

The success of this project can become a model for other schools in Mukomuko Regency or regions with similar characteristics. The value engineering approach applied—achieving maximum results with efficient costs—proves that quality facility construction does not always require large budgets.

Complete documentation from RAB to implementation becomes a valuable reference for education practitioners and civil engineers who want to develop similar projects. Process transparency and cost accountability also provide lessons in good educational project governance.

8. Challenges and Lessons: Implementation Reflection

Like construction projects in general, the construction of this computer laboratory faced several challenges that provided valuable lessons.

9. Adaptation to Weather Conditions

Mukomuko's tropical climate with high rainfall was the main challenge, especially during the casting and finishing phases. Rain can slow down the drying process of plaster and paint, potentially causing schedule delays.

The solution applied is flexible work scheduling with attention to weather forecasts. Exterior work is scheduled during the dry season, while interior work can be done in all weather. This adaptive approach minimizes weather impact on overall progress.

10. Multi-Stakeholder Coordination

Coordination between the school, consultants, contractors, and supervisors requires intensive communication. Technical understanding differences between non-technical stakeholders and field implementers sometimes cause miscommunication.

An important lesson is the importance of visual communication through working drawings and progress photo documentation. Weekly coordination meetings proved effective in aligning expectations and resolving problems before they develop into major obstacles.

11. Material Procurement in Rural Areas

The availability of quality materials in rural areas is sometimes limited, requiring procurement from the nearest city which impacts logistics and transportation costs. Mature material procurement planning from the start is key to avoiding delays due to stock shortages.

The successful strategy is building partnerships with reliable local suppliers, accompanied by strict quality control upon material receipt. This ensures material quality is maintained even when obtained from local suppliers.

V. CONCLUSION

The construction of the Computer Laboratory room at SMP Negeri 02 Mukomuko represents a significant achievement in digital education transformation efforts. This IDR 342 million project is not merely physical infrastructure investment, but an investment in the future of Mukomuko's younger generation.

With 85% progress as of October 2025 and 95% conformity to planning, this project demonstrates that quality construction with efficient budgets can be achieved through mature planning, disciplined execution, and strict supervision. Cost efficiency of 3% without sacrificing quality proves the effectiveness of the value engineering approach.

From a technical aspect, the building has met all SNI construction standards and national education facility standards. K-250 quality reinforced concrete structure, safe electrical system according to SNI 0225:2019, and tropical climate-responsive design ensure safety, comfort, and long-term sustainability.

However, the greatest impact lies in the educational and social dimensions. This facility will become a catalyst for learning method transformation, opening technology access for hundreds of students, and narrowing the digital divide between urban and rural areas.

For sustainability, routine maintenance commitment, digital learning content development, and continuous teacher training are required. This laboratory must continue to adapt to technological developments to remain relevant to future learning needs.

Finally, the success story of the computer laboratory construction at SMP Negeri 02 Mukomuko proves that with clear vision, mature planning, and professional execution, schools in rural areas can have facilities equal to schools in large cities. This is a concrete step toward equalization of national education quality and the realization of Indonesia's Golden 2045 promise

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