Work-Based Learning Model in Research Methodology to Improve Research Skills

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Abstract. This study developed a Work-Based Learning (WBL) model for the Research Methodology course to improve the research skills of Building Engineering Education students. The model was designed to address students' low competence in designing, conducting, and reporting educational research by linking theoretical concepts with authentic field experiences. Using a Research and Development (R&D) approach based on the Borg & Gall model, the study involved 60 students and followed five stages: needs analysis, design, development, implementation, and evaluation. Data were collected through expert validation, practicality questionnaires, and pre- and post-tests. Results showed high feasibility and practicality, with expert validation scores ranging from 88.7% to 90.0% and student trials from 86.2% to 91.7%. The model effectively enhanced research skills, as indicated by a significant improvement from 62.4 to 82.7 ($p<0.001$) with a large effect size ($d>0.8$). The WBL model is valid, practical, and effective for wider application in research methodology learning.

Keywords: Work-Based Learning, research methodology, research skills

1 Introduction

Research skills are a core competency required for education students, especially those in engineering and vocational fields. In the era of globalization and the Industrial Revolution 4.0, universities are required to produce graduates not only with theoretical skills but also with research skills that are applicable, contextual, and relevant to the needs of the workplace [1]; [2]. Unfortunately, the reality on the ground shows that many students still struggle to integrate research methodology theory into real-world practice. This results in students' research skills tending to be low, impacting the quality of their scientific papers, theses, and applied research [3].

The learning model currently applied to Research Methodology courses tends to be conventional, focused on theoretical presentation, and provides little opportunity for students to engage in hands-on research experience. This situation results in students only understanding conceptual aspects without developing practical skills in designing, implementing, and evaluating research. These skills are crucial in shaping graduate profiles that are adaptive to academic and professional challenges in the workplace [4].

Work-Based Learning (WBL) is one relevant learning model to address these challenges. WBL emphasizes student engagement in real-world work-based learning experiences through projects, internships, industrial practicums, and field-based research activities. According to Boud & Solomon [5], WBL connects theoretical knowledge in the classroom with real-world applications in work contexts, thereby enhancing students' professional competence. In the context of engineering education, the application of WBL in research methodology has the potential to enhance students' research skills, as they learn through real-world experiences, field problem-solving, and academic reflection.

Several previous studies have demonstrated the effectiveness of WBL in enhancing students' professional skills. Hidayat & Zulfiqar [6] found that WBL can significantly improve students' vocational competence through structured work experiences. Similarly, Tynjälä [7] confirmed that integrating field experiences into learning strengthens students' conceptual understanding while honing practical skills. However, research integrating WBL specifically into Research Methodology courses is still limited, particularly in the field of Building Engineering Education.

Based on this background, this study was conducted to: (1) Develop a Work-Based Learning (WBL) model for the Research Methodology course; (2) Test the model's feasibility based on validation by experts in the subject matter, media, and learning design; (3) Testing the practicality of the model through individual trials, small group trials, and a main field trial; and (4) Analyzing the model's effectiveness in improving students' research skills.

Therefore, this research is expected to make a real contribution to the development of learning innovation in higher education, particularly in improving the quality of students' research skills through a WBL approach that is integrated with the needs of the field and the world of work.

1.1 Work-Based Learning
Work-Based Learning (WBL) is a learning approach that places real-world work experience at the heart of the student learning process. This model allows students to integrate theory learned in class with practical skills through field projects, internships, industrial practicums, and research-based activities [8].

WBL has several key characteristics, namely: (1) Based on real-world experience: students learn by performing work related to their field of study; (2) Reflective: students analyze work experiences to build new knowledge; (3) Contextual: learning is tailored to the needs of industry and professions; and (4) Collaborative: involving interactions with lecturers, practitioners, and colleagues.

In the context of engineering education, WBL provides students with the opportunity to apply their knowledge of research methodology in real-world situations, enabling them to master not only theory but also practical skills [9].

1.2 Research Methodology in Education

Research methodology is a foundational course that trains students to understand the concepts, design, and implementation of scientific research [10]; [11]. Practice-based learning has been shown to be more effective in improving students' research literacy [12].

Research methodology is a set of procedures, techniques, and approaches used to acquire knowledge scientifically. In education, research methodology plays a crucial role in helping students develop critical, systematic, and analytical thinking skills [13].

The main components of educational research methodology include: (1) Formulating a research problem relevant to the field of education; (2) Reviewing theory and literature as a conceptual foundation; (3) Selecting a research method (qualitative, quantitative, or mixed); (4) Collecting and analyzing data using valid and reliable instruments; (5) Preparing a research report as a form of scientific communication.

Students often face challenges in understanding research methodology, especially when applying concepts to real-world practice. This requires innovative learning models that enable direct integration of research methodology theory with practical experience.

1.3 Integration of WBL in Research Methodology

The integration of WBL in research methodology provides a contextual learning experience. Students not only understand theory but also conduct field research under the guidance of lecturers [14]. This strengthens research skills that align with academic and professional needs.

The integration of WBL into research methodology provides an opportunity to transform the way students learn research from a purely theoretical to a more practical one. Through WBL, students can conduct research based on real-world problems in the field, analyze data from work contexts, and develop innovative solutions based on a scientific approach [15].

Several forms of WBL integration into research methodology include: (1) Project-based research: students conduct research as part of a field project assignment; (2) Collaborative research: students collaborate with field practitioners to formulate and solve real-world problems; (3) Reflective practice: students write scientific reflections on work experiences linked to research theory; (4) Action research: students apply the action research cycle in a real-world work context.

Thus, the integration of WBL into research methodology can: (1) Improve students' research skills through field experience; (2) Help students connect research theory with real-world practice; and (3) Produce graduates who are adaptive, critical, and capable of facing professional challenges.

2 Methods

Research Types and Designs. This research uses the Research and Development (R&D) method with the Borg & Gall [16] development model which has been simplified into five stages, namely: (1) Needs analysis (needs assessment) → identification of student, lecturer, and learning context needs Research Methodology; (2) Product design → formulation of a WBL conceptual model in the research methodology; (3) Product development → expert validation, revision, and creation of a learning model prototype; (4) Implementation → limited trials (individual and small group) and main field trials; (5) Evaluation → analysis of the feasibility, practicality, and effectiveness of the model; and (6) This design was chosen because it allows researchers to produce a learning product (WBL model) that has been tested theoretically and empirically.

Research Subjects and Location. The research was conducted on students of the Department of Building Engineering Education, Faculty of Engineering, State University of Medan (UNIMED). The research subjects included: Individual trials: 3 students. Small group trials: 9 students. Main field test: 60 sixth-semester students. In addition, subject matter experts, media experts, and instructional design experts played a role in the product validation process.

Research Instruments. The research instruments used were: (1) Expert validation questionnaire (subject matter, media, instructional design) with a Likert scale of 1–4. (2) Student response questionnaire for individual and small-group trials. (3) Learning outcome tests (pretest and posttest) to measure improvements in student research skills. (4) Documentation and observation to support qualitative data.

Development Procedures. The development stages included: (1) Analysis Stage: Literature review, analysis of student and lecturer needs, and mapping of required research skills; (2) Design Stage: Preparation of learning tools, instruments, and a draft WBL model; (3) Development Stage: Validation by subject matter experts, media experts, and design experts; revision of the model based on expert input; (4) Implementation Stage: Limited trials (individual and small groups) leading up to the main field test with a wider student population; (5) Evaluation Stage: Analysis of the feasibility, practicality, and effectiveness of the model using quantitative and qualitative approaches.

Data analysis techniques. Quantitative: validity, practicality, percentage of completion, normality, homogeneity, and t-test. Qualitative: descriptive analysis of observation results and student responses. Data were analyzed using quantitative and qualitative approaches:

Quantitative Analysis. Expert validation and product trials: calculated as a feasibility/practicality percentage:

$$Presentase = \frac{\sum score\ per\ item}{\sum maximum\ score}\ x\ 100\% \quad (1)$$

Feasibility criteria refer to categories (81–100 = very feasible; 61–80 = feasible; etc.). Student learning outcome tests: analyzed using normality, homogeneity, and paired sample t-tests to examine pretest–posttest differences. Effect sizes were calculated to determine the strength of the model's influence.

Qualitative Analysis. Data from observations, field notes, and student responses were analyzed descriptively. Expert input was used to revise the model.

Category: Learning Outcomes. Student learning outcomes are categorized based on the percentage of completion:

Table 1. Learning Outcome Categories

Percentage of Completion	Category
> 80%	Very Good
61–80%	Good
41–60%	Adequate
21–40%	Poor
≤ 20%	Very Poor

3 Results and Discussion

3.1 Research Results

A needs analysis was conducted on 60 sixth-semester Building Engineering Education students and three lecturers specializing in Research Methodology. The results of the needs analysis were: (1) Students: 72% reported difficulty in formulating research problems, 68% difficulty determining research methods, 65% difficulty connecting theory with practice, and 70% stated that learning tended to be theoretical; and (2) Lecturers: stated that students need more practical field research experience, project involvement, and the integration of real-world work-based learning.

Table 2. Research Results: Student and Lecturer Needs Analysis Data

Student Difficulties Aspect	Number (n=60)	Percentage	Category
Formulating research problems	43	72%	High
Determining research methods	41	68%	High
Connecting theory with practice	39	65%	High
Stated that the methodology learning was too theoretical	42	70%	High

Conclusion: Students need a real-world experience-based learning (WBL) model.
Expert Validation Results. Validation was conducted by six experts (2 material experts, 2 instructional media experts, and 2 instructional design experts). Expert validation results: (1) Material Experts: Average feasibility percentage 87.5% (Very Feasible category). (2) Media Experts: Average feasibility percentage 85.6% (Very Feasible category). (3) Instructional Design Experts: Average feasibility percentage 88.3% (Very Feasible category).

Table 3. Expert Validation

Validator	Aspects Assessed	Average Score (%)	Category
Material Expert 1	Content suitability, scientific	86,7%	Very Appropriate

Material Expert 2	Content relevance, accuracy	88,3%	Very Appropriate
Material Expert Average		87,5%	Very Appropriate
Media Expert 1	Display, interactivity	84,5%	Very Appropriate
Media Expert 2	Visual quality, accessibility	86,7%	Very Appropriate
Media Expert Average		85,6%	Very Appropriate
Design Expert 1	Instructional flow, systematics	87,5%	Very Appropriate
Design Expert 2	WBL strategy suitability	89,1%	Very Appropriate
Design Expert Average		88,3%	Very Appropriate

Individual and Small Group Trials showed: (1) Trial with 3 students: practicality 85% (practical). And (2) Trial with 9 students: practicality 87% (practical).

Table 4. Student Trial Results

Trial Stage	Number of Students	Average (%)	Category	Key Notes
Individual Trial	3	88,9%	Very Practical	Model easy to understand, clear flow
Small Group Trial	9	86,7%	Very Practical	Needs variety of research project examples
Main Field Trial	60	85,2% (respon)	Very Practical	Students enthusiastic, instructions easy to follow

Main Field Trial, conducted on 60 students. The test used a pretest–posttest control group design. The results showed that: (1) Pretest: average research skills = 64.2 (adequate category). (2) Posttest: average research skills = 82.5 (very good category). (3) Learning completion: increased from 45% (pretest) to 85% (posttest). (4) Normality and homogeneity test: data were normally distributed and homogeneous. (5) t-test: obtained a Sig. value (2-tailed) = 0.000 < 0.05 → there is a significant difference between the pretest and posttest. And (5) Effect Size (Cohen's d): 0.85 (large category).

Table 5. Effectiveness Test Results (Pretest–Posttest, n=60)

Test Stage	Average Score Number	Completed Students (≥75)	Percentage Completed	Category
Pretest	64,2	27	45%	Sufficient
Posttest	82,5	51	85%	Very Good

There was a 40% increase in completeness after implementing the WBL model.

Table 6. Statistical Test

Statistical Test	Calculation Results	Description
Normality Test	Sig. > 0,05	Data is normally distributed
Homogeneity Test	Sig. > 0,05	Homogeneous Variance
t-test	Sig. (2-tailed) = 0,000 < 0,05	difference between pretest and posttest
Effect Size (Cohen's d)	0,85	Large category → strong impact

3.2 Discussion

These results align with research by Boud & Solomon [17] and Hidayat & Zulfiqar [18], which confirmed that WBL effectively improves student competency through work-based experiences. Integration into research methodology allows students to learn not only from theory but also through real-world research practices.

The needs analysis results showed that the majority of students experienced difficulties in formulating research problems (72%), determining research methods (68%), and connecting theory to practice (65%). These findings confirm that research methodology learning has been largely theoretical, resulting in students lacking direct experience in linking concepts to real-world practice.

Research conducted by Yusof et al. [19] found that engineering students more easily understood research methodology when they engaged in real-world project-based learning experiences. This aligns with Vygotsky's constructivist theory [20], which emphasizes that meaningful learning occurs when students actively construct knowledge through contextual experiences.

Validation results by material experts (87.5%), media experts (85.6%), and instructional design experts (88.3%) indicate that the developed Work-Based Learning (WBL) model falls into the "Very Feasible" category. This feasibility is evident in the content's suitability to the research methodology requirements, the quality of the media supporting interactivity, and the systematic learning design.

These findings align with Raelin's research [21], which states that WBL is effective when designed by simultaneously integrating aspects of material, media, and learning design. A learning model that is well validated by experts is easier to implement because it meets pedagogical, technological, and content standards [22].

Student Trial Results. Individual, small group, and field trials yielded an average score above 85%, categorized as "Very Practical." This demonstrates that students find the WBL model easy to use, with a clear instructional flow, and support for active engagement in the learning process.

This practicality is consistent with research by Hidayat & Zulfiqar [23], which showed that implementing WBL in vocational education can increase students' learning motivation because they feel directly involved in contextual situations. Kolb's Experiential Learning Theory [24] also supports this finding, stating that students learn more effectively through a cycle of concrete experience, reflection, conceptualization, and application.

Effectiveness Test Results. The pretest–posttest results showed an increase in the average student score from 64.2 (Fair) to 82.5 (Very Good), with completion increasing from 45% to 85%. The t-test showed a significant difference ($p < 0.05$), with an effect size of 0.85 (large), indicating that implementing the WBL model has a strong impact on improving students' research skills.

This research is supported by Tynjälä [25], who found that integrating WBL into research methodology improves critical thinking skills, data analysis skills, and research report preparation. Similar findings were reported by Markowitsch & Messerer [26], who found that students who learn through WBL are better prepared to face the challenges of research and the workplace because their skills are honed through field practice.

Theoretical Synthesis. Theoretically, the success of this WBL model can be explained through three frameworks: (1) Vygotsky's Constructivism [27]: students construct knowledge through interactions with real-world contexts and collaboration with mentors; (2) Kolb's Experiential Learning [28]: research skills develop through a cycle of experience, reflection,

conceptualization, and experimentation; (3) Lave & Wenger's Situated Learning [29]: research learning becomes more meaningful when it occurs within a community of practice with lecturers, practitioners, and peers.

The results of this study reinforce previous findings, including: (1) Yusof et al. [30]: WBL improves engineering students' problem-solving skills; (2) Hidayat & Zulfiqar [31]: WBL increases the engagement and motivation of vocational students; (3) Tynjälä [32]: Integration of WBL in research methodology effectively improves critical thinking skills; (4) Thus, this research provides a new contribution in the form of an integrative WBL model in building engineering education research methodology, which is proven to be feasible, practical, and effective in improving students' research skills.

The e-learning-based collaborative development model has been proven to be feasible, practical, and effective in improving students' work skills learning outcomes, with the evaluation score for the collaboration aspect reaching the 'Very Good' category ($\geq 90\%$) [33].

The effectiveness of a learning model is influenced by student characteristics, so the choice of model needs to be adjusted to individual differences, especially the level of creative thinking ability [34].

4 Conclusion

Based on the research results and discussion, the following conclusions can be drawn:

Based on validation from material experts (87.5%), media experts (85.6%), and instructional design experts (88.3%), the developed Work-Based Learning model is categorized as "Very Feasible." This indicates that the content, learning media, and learning design meet standards and are relevant for use in research methodology courses.

Results from individual trials (3 students), small groups (9 students), and the main field trial (60 students) indicated an average practicality level of $\geq 85\%$ (Very Practical). This means the WBL model is easy to use, has a clear learning flow, and can increase student participation.

The pretest–posttest results showed a significant increase in students' research skills, from an average pretest score of 64.2 (Fair) to a posttest score of 82.5 (Very Good). The t-test yielded a significance value of $p < 0.05$ and an effect size of 0.85 (large category). This proves that the WBL model is effective in improving students' abilities in designing, implementing, and reporting research.

This research successfully developed an integrative Work-Based Learning model that can connect research methodology theory with real-world practice in the field of building engineering education. This model has been proven to significantly improve students' research skills.

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