© JAN 2026 | IRE Journals | Volume 9 Issue 7 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I7-1714093

Engineering Analysis of Democratic Leadership Impact on Team Performance under Different Stress Levels

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Abstract- ***Democratic leadership is widely promoted in engineering education due to its potential to enhance participation, communication, and ethical reasoning. However, its effectiveness under stressful, time-constrained conditions remains insufficiently explored. This study investigates the impact of democratic leadership on team performance among Mechanical Engineering students under varying stress levels. A quasi-experimental case study was conducted involving ten Mechanical Engineering students divided into two democratically led teams. The teams completed three tasks of increasing complexity: a cognitive task, a collaboration-intensive task, and an ethical decision-making scenario. Performance was evaluated using task accuracy, completion time, and response quality, while team dynamics were assessed through a post-task survey. Results show that 70% of participants reported improved communication, 60% reported enhanced problem-solving, and 60% expressed satisfaction with team performance under stress. However, findings also indicate that unstructured participation may delay decision-making. The study concludes that democratic leadership is most effective when combined with clear role assignment and structured task management in engineering teams.***

Index Terms- ***Democratic Leadership, Engineering Education, Stress Management, Team Performance, Ethical Decision-Making***

I. INTRODUCTION

Democratic leadership was extensively studied during the 20th century by psychologist Kurt Lewin and his colleagues as part of early efforts to understand how leadership behavior affects group performance. This leadership style emphasizes shared decision-making, open communication, and active participation of team members. Instead of relying on top-down authority, leaders act as facilitators who guide the team while ensuring that all members contribute to the decision-making process.

In modern engineering practice, teamwork and collaboration are essential due to the multidisciplinary nature of projects and the need for innovation. Engineering teams often operate under high-pressure conditions, including tight deadlines, limited resources, and critical technical challenges. While democratic leadership is known to promote creativity and engagement, questions remain regarding its effectiveness in such stressful environments where rapid and accurate decisions are required.

This study aims to explore how democratic leadership influences team performance under different stress levels among Mechanical Engineering students. By examining communication, problem-solving, decision-making, and ethical reasoning, this research seeks to identify the strengths and limitations of democratic leadership in academic engineering teams.

II. STATEMENT OF THE PROBLEM

This study sought to determine how democratic leadership affects the team performance of Mechanical Engineering students at the Nueva Ecija University of Science and Technology under varying stress levels. Specifically, the study aimed to answer the following questions:

1. How does democratic leadership influence:
- Team communication
- Problem-solving capabilities
- Decision-making involvement

2. How do teams perform under different stress conditions in terms of:
- Task completion time
- Quality of output
- Team satisfaction

3. Which variables significantly influence team performance considering:
- Stress level (low, moderate, high)
- Team size

4. Is there a significant relationship between democratic leadership and team performance under varying stress levels?

III. METHODOLOGY

3.1 Research Design

A quasi-experimental case study design with survey data was employed to observe leadership dynamics in a controlled academic environment. This approach allowed direct observation of team interactions while maintaining realism through task-based stress simulation.

3.2 Participants

The participants consisted of randomly selected Mechanical Engineering students from the Nueva Ecija University of Science and Technology who were assigned to two teams of five members each. Team leaders were chosen through a democratic voting process

3.3 Stress Manipulation and Tasks

Stress was operationalized by increasing task complexity and reducing time allowances across three sequential tasks:
- Task 1 (Low Stress): Crossword puzzle under time limit
- Task 2 (Moderate Stress): Collaboration-intensive problem-solving task
- Task 3 (High Stress): Ethical decision-making scenario requiring consensus under time pressure

3.4 Instruments and Data Analysis

Team performance was evaluated using a rubric measuring accuracy, task completion time, and response quality. Team dynamics were measured using a post-task survey with a five-point Likert scale assessing communication, participation, stress management, and leadership effectiveness. Observational notes were recorded throughout the activities. Data were analyzed using descriptive statistics and cross-team comparisons.

IV. RESULT

4.1 Task Performance Under Stress

Mechanical Engineering students were divided into two democratically led teams of five members each. In Task 1, Team 1 successfully submitted the task on time (100%), while Team 2 completed the task but failed to submit it within the time limit (0%). Observations indicated that Team 1 was cautious but organized, while Team 2 demonstrated strong interpersonal comfort but weak time management.

In Task 2, Team 1 submitted one more correct answer than Team 2, reflecting improved coordination and role clarity. Team 2 maintained accuracy but required more time to reach consensus, indicating slower decision-making under democratic discussion.

In Task 3, Team 1 delivered a well-structured but incorrect answer, while Team 2 produced the correct decision with a weaker explanation. These contrasting outcomes highlight trade-offs between leadership articulation and collective accuracy under stress.

4.2 Survey Results: Team Communication

Survey data showed that democratic leadership positively affected communication:
- 70% (7/10) agreed that communication improved
- 50% strongly agreed discussions were open and respectful
- 60% agreed they felt heard by their teammates
- 60% agreed communication remained effective under stress

4.3 Survey Results: Problem-Solving Capabilities

Results indicated strong perceived problem-solving benefits:
- 50% strongly agreed leaders encouraged brainstorming

- 50% strongly agreed solutions were more creative
- 60% strongly agreed teams solved problems effectively under stress
- 60% agreed democratic leadership improved efficiency

However, one team's failure to submit Task 1 on time highlights the need for clearer task delegation despite high collaboration.

4.4 Decision-Making Involvement

Decision-making involvement was high:

- 50% agreed they were actively involved in decisions
- All participants reported that decisions were made collectively
- Participants expressed satisfaction with the democratic process despite time pressure

4.5 Stress and Performance

Stress influenced speed but not morale:

- 50% agreed stress reduced task completion speed
- 40% agreed work quality remained high
- 50% agreed democratic leadership reduced stress
- 60% strongly agreed they were satisfied with team performance under stress

V. DISCUSION

The results indicate that democratic leadership enhances communication, engagement, and ethical reasoning among Mechanical Engineering students. With 60–70% of participants reporting positive effects, the findings support leadership theories emphasizing participation and shared ownership. However, task performance data reveal that unstructured participation can delay decision-making under time pressure. These results align with studies advocating for structured democratic leadership, where participation is balanced with role clarity and time management. For engineering educators, this suggests that leadership instruction should include explicit frameworks for delegation and decision-making in team-based learning.

VI. CONCLUSION

Democratic leadership positively influences team communication, participation, and satisfaction among Mechanical Engineering students, particularly under stressful conditions. However, its effectiveness depends on clear structure, role definition, and time management. When appropriately scaffolded, democratic leadership can serve as a powerful instructional strategy for developing leadership and teamwork competencies in engineering education.

VII SOLUTIONS AND RECOMMENDATIONS

1. Apply democratic leadership in engineering team settings to improve participation and collaboration.
2. Use tasks with varying difficulty levels to help teams develop resilience under stress.
3. Include ethical scenarios in engineering exercises to strengthen professional responsibility.
4. Encourage team leaders to explain decisions to enhance reflection and learning.

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