

Development of SMART-Based Soft Skills: Integration of STEM, HOTS Based on Project-Based Learning for Vocational Students

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Abstract. The 21st-century workforce requires a strong foundation in both technical and soft skills, particularly in vocational education. This study investigates the development of soft skills among vocational students through the SMART model, integrating STEM (Science, Technology, Engineering, and Mathematics) and HOTS (High Order Thinking Skills) within a project-based learning (PBL) framework. The aim is to foster critical soft skills, such as problem-solving, collaboration, and communication, essential for adapting to the ever-evolving demands of the modern workforce. The study explores the impact of this integrative approach and assesses students' progress through a series of technical projects. Preliminary findings suggest that the SMART model can significantly enhance students' preparedness for the workforce, equipping them with the necessary skills to thrive in complex and dynamic environments.

Keywords: SMART model, soft skills, STEM, HOTS, project-based learning, vocational education

1 Introduction

State of the Art related to the title "Development of SMART-Based Soft Skills: Integration of STEM, HOTS based on Project-Based Learning for Vocational Students" covers both past and recent studies that emphasize the importance of integrating STEM, HOTS, and project-based learning in enriching and developing the soft skills of vocational students to prepare them for the dynamic demands of the workforce. Details are shown in the table below:

Table 1. State of the Art Smart Based Soft Skill

Research on the Development of Vocational Students' Soft Skills	Research on STEM in Vocational Education	Research on HOTS in Vocational Education	Research on the Application of Project-Based Learning in Vocational Education	Re-cent Research: Integra-tion of Soft Skills, STEM, HOTS, and Project-Based Learning in Vocational Educa-tion
(1) (2) (3) (4) (5) (6) (7)	(8) (9) (10) (11) (12) (13) (14)	(15) (16) (17) (18) (19) (20) (21)	(22) (23) (24) (25) (26) (27)	(28) (29)
The studies indicate the significance of developing soft skills for vocational students. These studies demonstrate that the development of soft skills such as communication, teamwork, and analytical skills has a significant impact on students' readiness to enter the workforce	STEM (Science, Technology, Engineering, and Mathematics) has become a key focus in vocational education research. These studies highlight that the integration of STEM can enhance students' conceptual understanding and the application of high-order thinking skills (HOTS) in vocational education	Research on HOTS development in vocational education has shown the importance of training vocational students to think analytically, critically, and creatively to prepare them for the challenges of the modern workforce.	The application of project-based learning has emerged as an increasingly popular method in vocational education. These studies suggest that project-based learning encourages students' active participation in projects, which helps to enhance their practical skills.	Recent studies reveal a limited amount of research that holistically examines the integration of soft skills, STEM, HOTS, and project-based learning. This integration is crucial for improving vocational students' readiness to enter a competitive job market.

1.1 Novelty of the Research

The novelty of the research "Development of SMART-Based Soft Skills: Integration of STEM, HOTS Based on Project-Based Learning for Vocational Students" lies in its holistic approach that combines the SMART (Specific, Measurable, Achievable, Relevant, Time-bound) concept with STEM integration, the application of High Order Thinking Skills (HOTS), and project-based learning in vocational education. This research explores a new approach to strengthening vocational soft skills by unifying innovative concepts into a comprehensive learning framework.

This study focuses on the development of soft skills in vocational students using the SMART model. SMART, an acronym for Specific, Measurable, Achievable, Relevant, and Time-bound, is a structured approach that helps ensure that learning outcomes are clearly defined and aligned with students' needs. By integrating STEM and HOTS with PBL, students are given opportunities to apply their knowledge in real-world contexts while simultaneously enhancing their soft skills (Blumenfeld et al., 1991).

The primary objective of this research is to explore the effectiveness of this integrative model in improving the soft skills of vocational students, particularly in problem-solving, teamwork, and communication. Through this approach, we aim to provide a framework that can be adopted by vocational education institutions to better prepare students for the challenges of the modern workforce.

2 Literature Review

2.1 Soft Skills in Vocational Education

The development of soft skills has become a critical area of focus in vocational education, as employers increasingly prioritize interpersonal abilities alongside technical skills. Soft skills, such as communication, adaptability, and teamwork, are essential for vocational graduates to succeed in industries that demand both expertise and collaboration.

2.2 The Role of STEM in Soft Skills Development

STEM education is not only essential for technical proficiency but also plays a vital role in fostering problem-solving and critical thinking. Through the application of interdisciplinary knowledge in STEM, students develop analytical and creative thinking, which are key components of soft skills. Moreover, STEM-related projects often require students to work in teams, further enhancing their communication and collaboration.

2.3 High Order Thinking Skills (HOTS)

HOTS encourages students to engage in higher levels of cognition, such as analysis, synthesis, and evaluation. In the context of vocational education, HOTS is critical for equipping students with the ability to solve complex problems, think critically about technical challenges, and develop innovative solutions in real-world settings.

2.4 Project-Based Learning (PBL)

PBL is an active learning approach that requires students to engage in extended, real-world projects, thereby fostering a deeper understanding of the subject matter. In vocational education, PBL encourages the practical application of technical knowledge and promotes the development of soft skills through teamwork and project management.

3 Methodology

This study employs a mixed-methods approach to evaluate the effectiveness of the SMART model in integrating STEM, HOTS, and PBL to develop soft skills among vocational students. The study was conducted at a vocational school where students participated in a series of STEM-based projects designed to improve their problem-solving, communication, and collaboration skills.

3.1 Participants

The participants included 100 vocational students from the Management Informatics program, divided into three levels based on their semesters (II, IV, and VI). The students were enrolled in courses that incorporated STEM-related content, such as Java Programming and Web Programming. They were tasked with completing team-based projects that required both technical and soft skill applications.

3.2 Instruments

Pre- and Post-Project Surveys: Students were surveyed before and after the project to assess their self-perceived soft skill development.

Performance Rubrics: A rubric was used to evaluate students' problem-solving, communication, and teamwork during the projects.

Interviews and Focus Groups: In-depth interviews and focus group discussions were conducted to gain qualitative insights into students' experiences with the project-based learning approach.

3.3 Data Analysis

The data were analyzed using both qualitative and quantitative methods. Pre- and post-survey results were analyzed using paired sample t-tests to measure changes in students' soft skills. The qualitative data from interviews and focus groups were thematically analyzed to identify key themes related to the challenges and benefits of the SMART model.

4 Results and Discussion

4.1 Results

Improvement in Soft Skills.

Preliminary findings show a significant improvement in students' problem-solving abilities ($p < 0.05$), teamwork, and communication skills. Students reported increased confidence in applying technical knowledge to real-world challenges and improved their ability to work collaboratively in teams.

Challenges Faced.

Students indicated that time management and the ability to communicate complex technical concepts were among the most challenging aspects of the project-based learning approach. However, regular guidance from instructors helped mitigate these challenges.

Feedback from Students.

Students expressed positive feedback regarding the use of real-world projects to apply their STEM knowledge. They highlighted the practical value of developing soft skills through collaborative problem-solving tasks and appreciated the structured guidance provided by the SMART model.

4.2 Discussion

The results of this study confirm the effectiveness of integrating STEM and HOTS with the SMART model in vocational education. By focusing on real-world applications through PBL, students developed essential soft skills that are crucial for success in the workforce. The SMART model's structured approach ensured that students' learning objectives were clearly defined and achievable, making the process of skill development more efficient and measurable.

This study contributes to the growing body of literature on vocational education by providing evidence that project-based learning, when coupled with STEM and HOTS, is a powerful tool for fostering both technical and interpersonal skills. The challenges faced by students, such as time management and communication, highlight areas where additional support may be necessary, particularly in preparing students to articulate technical ideas more clearly.

5 Conclusion

The integration of STEM, HOTS, and project-based learning within the SMART model offers a promising approach to developing soft skills in vocational students. By engaging in real-world projects that require both technical and interpersonal abilities, students are better equipped to meet the demands of the 21st-century workforce. Future research should explore how these findings can be applied across other vocational programs to enhance the scalability and impact of the SMART model in education.

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