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Research Article

FORMATION OF PROFESSIONAL COMPETENCE OF STUDENTS OF TECHNOLOGICAL EDUCATION

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ABSTRACT

This article explores the processes and pedagogical strategies required to develop the professional competence of students in technological education. It emphasizes the relevance of integrating professional knowledge, skills, and values essential for preparing future specialists in technology-related fields. Using contemporary educational paradigms, the article identifies key components influencing the formation of professional competence, including the role of practical activities, interdisciplinary integration, and digital tools. It also provides recommendations for educators and institutions to effectively nurture competencies that align with the evolving demands of the workforce.

KEYWORDS

Professional competence, Technological education, Practical learning, Digital tools, Interdisciplinary integration.

INTRODUCTION

The formation of professional competence among students in technological education has become increasingly vital in response to rapid advancements in science, technology, and industry. In today's globalized and dynamic environment, the demand for highly skilled professionals capable of addressing complex technological challenges has surged. As a result, educational institutions are tasked with preparing students not only to acquire theoretical knowledge but also to develop practical skills, critical thinking, and the ability to adapt to the evolving demands of the workforce.

Professional competence refers to the ability to apply knowledge and skills effectively in a real-world professional context. It encompasses not only technical proficiency but also creativity, problem-solving abilities, ethical decision-making, and

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interpersonal skills. In technological education, the challenge lies in equipping students with a balanced combination of theoretical foundations, hands-on experiences, and interdisciplinary knowledge to ensure they are well-prepared for the job market.

This article explores the various components, challenges, and strategies involved in the formation of professional competence among students pursuing technological education. It aims to identify the pedagogical practices that foster competence development and the institutional efforts needed to align educational outcomes with industry expectations. By addressing these aspects, this study provides a comprehensive framework to guide educators and institutions in building a learning environment that promotes the growth of well-rounded, competent professionals ready to contribute effectively to their fields.

LITERATURE REVIEW

The concept of professional competence in technological education has been explored extensively across various disciplines, including education, psychology, and management. Scholars have emphasized that professional competence extends beyond the acquisition of knowledge, encompassing a blend of skills, values, and attitudes necessary for real-world application. This section reviews key literature on the topic, highlighting important trends and challenges in fostering competence among students in technological education.

Competency-Based Education (CBE) emphasizes the development of specific skills and competencies required in professional settings. Korthagen and Meijer (2014) argue that CBE is essential for bridging the gap between theory and practice, particularly in technical and vocational education. This approach shifts the focus from traditional assessments to measuring mastery of competencies through project-based work, case studies, and real-world applications. It ensures students are equipped to meet job market demands, progressing at their own pace while achieving clear learning outcomes.

Research has consistently shown that practical learning experiences play a significant role in developing professional competence. Thomas (2020) emphasizes that project-based learning (PBL) promotes critical thinking, teamwork, and problem-solving skills, as students engage with real-world challenges. Work-based learning and internships provide students with the opportunity to apply theoretical knowledge, enhancing their skills and professional identity (Gupta & Bhushan, 2020). These experiences also facilitate the development of soft skills, such as communication and collaboration, which are essential in today's workforce.

The literature highlights the importance of interdisciplinary education in technological competence development. According to Falloon (2021), the integration of subjects like mathematics, physics, and environmental sciences within technological education enables students to approach problems from multiple perspectives. This approach fosters creativity, innovation, and analytical thinking, preparing students for complex and interdisciplinary tasks in professional settings.

With the increasing digitalization of industries, digital literacy has become a key component of professional competence. Several studies point to the importance of incorporating digital tools, virtual labs, and e-

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learning platforms into the curriculum to prepare students for a technology-driven workforce (Rosenberg, 2021). Digital platforms enable students to practice and enhance their technical skills beyond the physical classroom, promoting experiential learning. As industries increasingly rely on data analytics, programming, and artificial intelligence, the development of digital competence has become essential.

Despite the importance of professional competence, several challenges persist in its development. One major challenge is the misalignment between academic programs and industry requirements. As technologies evolve rapidly, educational institutions struggle to update their curricula in time, leading to a skills gap among graduates (Gupta & Bhushan, 2020). Furthermore, limited access to practical learning resources, especially in resource-constrained institutions, hinders the development of hands-on skills. Teacher preparedness is another critical factor, as instructors need continuous professional development to keep pace with emerging technologies and pedagogical innovations (Korthagen & Meijer, 2014).

Innovative teaching methods have gained popularity as effective tools for fostering competence. Collaborative learning, flipped classrooms, and blended learning approaches have been found to enhance students' engagement and deepen their understanding (Falloon, 2021). Competency-based assessments, reflective practices, and continuous feedback mechanisms also contribute to the professional development of students, promoting self-awareness and continuous improvement.

METHODOLOGY

The research methodology section outlines the approach used to investigate the processes involved in forming professional competence among students in technological education. A mixed-methods research design was employed, combining both qualitative and quantitative methods to gain a comprehensive understanding of the factors that contribute to competence development. The study focused on identifying effective teaching strategies, challenges, and student outcomes in technological education programs.

Research Design

The study utilized a mixed-methods design to capture the complexity of competence formation. This approach allowed the integration of numerical data from surveys with in-depth insights obtained through interviews and observations.

1. **Quantitative Component:**

o Surveys were conducted with students and educators to measure perceptions of competence development and assess the effectiveness of educational strategies.

o Statistical analysis was applied to examine correlations between teaching practices, practical exposure, and student competence levels.

2. **Qualitative Component:**

o In-depth interviews were carried out with educators, industry professionals, and students to understand their experiences and challenges.

o Classroom observations were used to document the implementation of innovative teaching practices and analyze student engagement.

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Participants

The study involved the following participants:

- Students: 150 students enrolled in technological education programs at three universities. Participants were selected using a stratified random sampling method to ensure a diverse representation of different academic levels and specializations.
- Educators: 25 instructors teaching technical and engineering subjects across the participating universities.
- Industry Professionals: 10 experts from technology-driven industries who collaborate with educational institutions through internships and joint projects.

Data Collection Tools

1. Questionnaires:

o A structured questionnaire was administered to students and educators to assess their perspectives on competence formation.

o The survey included Likert-scale items measuring the importance of theoretical knowledge, practical skills, interdisciplinary activities, and digital tools in competence development.

2. Interviews:

o Semi-structured interviews were conducted to gain deeper insights into the challenges, teaching methods, and learning experiences.

o Interviews with industry professionals provided perspectives on the alignment of academic programs with workforce needs.

3. Classroom Observations:

o Observations were carried out in project-based classes, practical labs, and internships to document teaching practices and student participation.

o Observation protocols focused on student engagement, collaboration, and problem-solving activities.

4. Document Analysis:

o Institutional curricula and policy documents were reviewed to assess the integration of competence-based education principles.

Data Analysis

1. Quantitative Data Analysis:

o Descriptive statistics were used to summarize survey responses.

o Correlation analysis was performed to identify relationships between educational strategies and the development of competencies.

o Regression analysis determined the impact of specific factors (such as internships, digital tools, or interdisciplinary projects) on professional competence.

2. Qualitative Data Analysis:

o Thematic analysis was used to identify recurring themes from interview transcripts and observation notes.

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o Coding was applied to categorize data into themes such as "practical learning," "digital competency," and "challenges in competence formation."

o Triangulation was employed by cross-referencing data from interviews, observations, and surveys to enhance reliability.

This study acknowledges certain limitations:

- The sample size, although representative, may not capture all variations across different institutions or regions.
- As the study focused on specific technological education programs, the results may not be fully generalizable to other fields of education.
- Observations were conducted over a limited period, which might not reflect all aspects of student engagement throughout the academic year.

RESULTS

This section presents the findings from the mixed-methods research conducted to explore the formation of professional competence among students in technological education. The analysis is divided into quantitative and qualitative results, with key themes and insights emerging from the data.

Quantitative Results

Survey Analysis

The survey responses from 150 students and 25 educators were analyzed to evaluate the effectiveness of teaching strategies, practical exposure, and digital tools in competence development.

- **Perceptions of Competency Development**

o 84% of students agreed that practical learning activities such as internships and project-based tasks contributed significantly to their competence development.

o 72% of students rated digital tools (like simulations and virtual labs) as highly effective in enhancing their technical skills.

o 68% of educators reported integrating interdisciplinary topics to foster problem-solving abilities.

- **Impact of Educational Strategies on Competence Formation**

A correlation analysis was performed to identify the relationships between different teaching strategies and competence development.

o Practical learning activities (internships, PBL): $r = 0.76$ (strong positive correlation with competence development).

o Use of digital tools: $r = 0.67$ (moderate positive correlation).

o Interdisciplinary teaching methods: $r = 0.55$ (moderate positive correlation).

Regression Analysis

A regression analysis was conducted to assess the influence of different factors on students' professional competence.

- Practical learning accounted for 45% of the variance in competence development ($p < 0.05$).

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- Digital tools explained 32% of the variance ($p < 0.05$).
- Interdisciplinary activities contributed 22% of the variance ($p < 0.05$).

These results confirm that hands-on learning and digital competencies play a vital role in developing professional competence among students.

Qualitative Results

Thematic Analysis of Interviews and Observations

Through thematic analysis of interviews with educators, students, and industry professionals, the following key themes emerged:

- **Theme 1: Practical Learning as a Foundation for Competence Development**

Both students and educators emphasized the importance of internships, workshops, and real-world projects. A student participant stated, "Internships gave me the chance to apply what I learned in class and understand the real challenges in the field." Educators confirmed that practical exposure significantly boosted students' confidence and skills.

- **Theme 2: Digital Competency as a Crucial Skill**

Educators and industry professionals agreed that digital tools and platforms are essential for competence development in today's technology-driven environment. An industry expert noted, "Graduates with hands-on experience in software and digital tools have a distinct advantage in the job market."

- **Theme 3: Interdisciplinary Integration Promotes Creativity and Innovation**

Interdisciplinary projects encouraged students to think critically and explore solutions from multiple perspectives. Observations of project-based classes showed that students were more engaged when working on tasks requiring input from various disciplines.

- **Theme 4: Challenges in Competence Formation**

Educators identified challenges such as outdated curricula and limited access to practical resources. They stressed the need for continuous curriculum updates to keep pace with technological advancements. Additionally, students highlighted the importance of having supportive mentors during internships.

Key Findings

1. Practical learning activities (internships, workshops, project-based learning) emerged as the most significant factor in competence development, with a strong correlation ($r = 0.76$) to student outcomes.

2. Digital tools and platforms were found to enhance both technical and analytical skills, demonstrating their importance in modern education.

3. Interdisciplinary integration encourages innovation and deeper learning but requires more effort from educators to design effective cross-disciplinary activities.

4. Challenges such as curriculum misalignment and resource limitations hinder the development of

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professional competence, underscoring the need for continuous improvements in teaching practices and institutional support.

The findings confirm that the formation of professional competence in technological education requires a well-rounded approach, combining theoretical knowledge with practical learning, digital skills, and interdisciplinary activities. Practical experiences emerged as the most influential component, reinforcing previous studies (Thomas, 2020; Gupta & Bhushan, 2020) that highlight the importance of hands-on learning.

However, challenges remain. The study revealed that despite the effectiveness of digital tools, not all institutions have adequate access to modern technologies, creating disparities in competence formation. Moreover, educators need continuous professional development to keep up with changing industry trends and integrate innovative teaching practices effectively.

CONCLUSION

The formation of professional competence in students pursuing technological education is a complex yet essential process for preparing them to meet the challenges of the rapidly evolving technological landscape. This study has highlighted the significance of a multifaceted approach to competence development, incorporating practical learning, digital tools, interdisciplinary integration, and continuous professional reflection.

The findings emphasize that practical learning activities such as internships, workshops, and project-based learning play the most crucial role in developing student competence, bridging the gap between theoretical knowledge and real-world application. Additionally, digital tools are critical in enhancing technical and analytical skills, equipping students with the capabilities needed for the technology-driven workplace. Interdisciplinary learning fosters creativity, problem-solving abilities, and innovation, which are increasingly in demand in modern industries.

Despite the effectiveness of these strategies, the research revealed several challenges, including curriculum misalignment with industry needs, limited access to practical resources, and a need for continuous professional development for educators. Addressing these challenges requires educational institutions to regularly update curricula, establish stronger collaborations with industries, and invest in teacher training programs.

In conclusion, the formation of professional competence among students in technological education demands a comprehensive and dynamic educational approach. By implementing innovative teaching strategies, integrating modern technologies, and promoting hands-on learning, institutions can ensure students develop the skills, knowledge, and values required for professional success. The findings of this study provide a roadmap for educators, policymakers, and institutions to align educational practices with the evolving needs of the workforce, ultimately contributing to the development of competent professionals ready to excel in their fields.

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