Programming Skills as a Catalyst for Managerial Competence and Everyday Problem-Solving*

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Abstract

The study explores the role of programming skills in shaping managerial competences and their applicability in everyday problem-solving. The motivation for this research lies in the growing importance of digital and algorithmic thinking in Industry 4.0, where organizations increasingly require managers who can apply systematic approaches to decision-making. While previous studies have emphasized the value of programming in STEM education, a gap exists in understanding how management students perceive the usefulness of programming skills both in their professional roles and in daily life. To address this gap, the research employed a questionnaire survey among 121 students of the Faculty of Management Engineering at Poznań University of Technology, asking them to evaluate the extent to which programming skills influence managerial abilities and assist with everyday tasks. The findings indicate that programming is not widely perceived as directly enhancing management competences, with only 30% of respondents recognizing such an impact, and just 8% rating it as essential. Nevertheless, students acknowledged the significant cognitive benefits of programming, particularly in logical thinking, structured problem-solving, and dividing complex tasks into manageable components, all of which were rated highly useful in everyday contexts. These results suggest that programming education offers valuable transferable skills that extend beyond technical contexts. The study highlights the opportunity to enrich management curricula with programming-related elements, thereby fostering algorithmic thinking that supports both professional decision-making and everyday problem-solving.

Keywords: programming skills, management skills, everyday problem-solving, industry 4.0.

Introduction

In today's rapidly changing business environment, technological skills, such as programming, are increasingly viewed as critical for improving efficiency, fostering innovation, and enhancing competitiveness. Industry 4.0, characterized by automation, data exchange, and smart technologies, has brought the relevance of programming skills to the forefront, particularly in management roles. Agile methodologies and algorithmic management have emerged as effective responses to the speed of business transformation and the growing need to adapt to changes. Despite the clear demand for digital skills in the workplace, there remains a gap in understanding how programming skills impact managerial competencies and decision-making processes. Learning programming and algorithms has become an integral part of preparing future professionals, offering skills that are highly sought after by employers and necessary for thriving in technology-driven industries.

Existing research highlights the influence of programming on the development of key skills, such as logical thinking, problem-solving, and creativity, especially in the context of STEM education (Hebebci et al., 2022; Topsakal et al., 2022). Studies demonstrate that programming education can enhance critical thinking and analytical skills (Kalelioğlu et al., 2014; Psycharis et al., 2017). However, there is limited research on how management students perceive the usefulness of programming skills, both in professional contexts and in everyday problem-solving. The majority of studies focus on technical or STEM students, leaving a gap in understanding how non-technical students, particularly those studying management, value programming skills in relation to their future careers (Elbyaly et al., 2023; Budak et al., 2019).

This study aims to address this gap by investigating the extent to which programming skills influence the development of managerial competences and how these skills can be applied in everyday life to solve problems. By identifying the skills that management students consider important, this research seeks to provide insights into how programming education can be tailored to strengthen managerial abilities and enhance everyday problem-solving, aligning with both student expectations and industry needs.

Literature Review

Modern management and organizational solutions, adapted to the specifics of work, bring significant benefits to both employees and employers, while supporting economic growth and the competitiveness of enterprises (Claus, 2019; Tataru, 2019; Burak et al., 2020; Harasim, 2013). In the era of globalization and dynamically developing technologies, a systems approach, treating the organization as a complex social system, allows for a better understanding of the interactions between individual elements of the enterprise (Ormerod, 2020; Maass et al., 2018; Roth, 2019; Koźmiński, 2013). Global economic processes and rapid technological progress make knowledge a key resource for both enterprises and entire economies, which increases competitiveness in the global market (Yang et al., 2021; Stavytskyy, 2019; Almeida, 2018; Szalkowski, 2006).

In this context, programming skills are gaining importance, especially in the context of increasing automation, digitalization and the development of technologies related to Industry 4.0. The literature emphasizes that programming is no longer the domain of IT specialists only, but is used in many industries, such as management, marketing or data analysis (Hebebci et al., 2022; Kalelioğlu and Gülbahar, 2014; Ragin-Skorecka et al., 2023). These skills allow employees to optimize processes, effectively manage data and implement innovative solutions, which is crucial in a dynamically changing business environment.

Programming develops a range of cognitive skills, including logical, abstract and critical thinking, which makes it extremely valuable in a managerial context (Budak et al., 2019; Psycharis and Kallia, 2017). These skills are particularly important in the decision-making process in management, where data analysis and problem-solving become key competencies. Learning programming teaches a systematic approach to problems, dividing complex issues into smaller elements and searching for the most effective solutions, which makes it a valuable resource in the modern labor market.

Although the literature offers many studies on the importance of programming skills in technical education, there is a research gap regarding the perception of these skills in the context of management students. Most of the existing studies focus on STEM students, while little attention has been paid to how programming affects the development of management competences and everyday problem solving of non-technical students (Elbyaly and Elfeky, 2023; Topsakal et al., 2022). This study fills this gap by investigating how programming skills are perceived by management students in the context of their future professional roles and daily lives.

Research Methodology

The research aims to explore the extent to which programming skills contribute to the development of management competences and how these skills can be applied to everyday problem-solving. The objective of the analysis is to demonstrate how programming enhances managerial abilities and facilitates day-to-day tasks. The research goal and questions guided the selection of the methodology – a questionnaire survey. Technically, this research involves well-defined respondents providing answers that form a logical, consistent, and coherent set of responses aimed at addressing the research problem (Matejun, 2016). The chosen research method was an online survey. The collected data did not require anonymization. The study addressed two key questions:

- How much do you think programming skills affect management skills?

– How can programming skills come in handy in everyday life?

For the first question, respondents selected a value from 1 to 5, where 1 indicated "redundant" and 5 indicated "key." For the second question, respondents were able to choose any number of items from a predefined list, which included: logical thinking, abstract thinking, easier troubleshooting, breaking down the problem into smaller parts, striving to find optimal solutions, use of algorithms to solve problems, knowledge of concepts, improving work efficiency, understanding programming structures, awareness of the software life cycle, preparation of a simulator/prototype, and awareness of multiple possible solutions to a problem. Additionally, respondents had the option to provide their own answers.

The survey focused on students from the Faculty of Management Engineering at the Poznań University of Technology, including both Polish and international students, to gather feedback on the educational process at the university. The respondents' place of residence was not considered relevant to the results and was excluded from the analysis as a deliberate limitation. Participants were selected purposefully by sending an email request to 1,159 students from the university, with responses received from 121 individuals, resulting in a response rate of approximately 10%.

To ensure ethical standards, the study was approved by the Committee for Ethics of Scientific Research at the Poznań University of Technology, following the submission of a formal application.

Results And Discussion

It can be concluded that for the respondents programming skills do not have a significant impact on management skills. Only 30% of positive answers were obtained in the survey, of which 8% were definite – 5 points (Fig. 1).
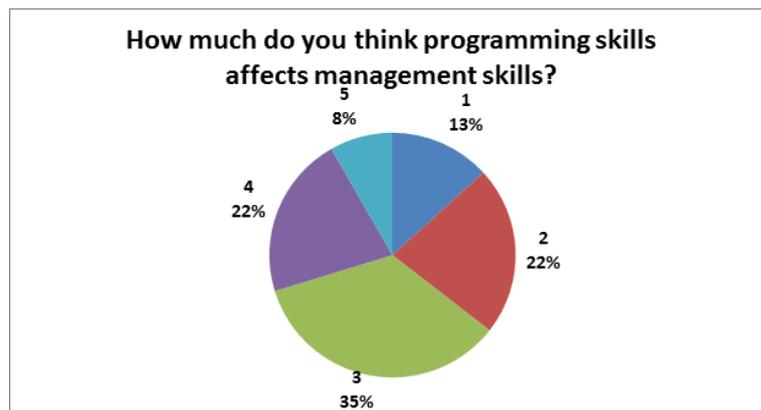

Fig. 1. Survey results to assess how much programming skills affects management skills

Source: own study (N=121)

If we distinguish between the answers given by first-cycle and second-cycle students, we do not notice any significant differences. It may even come as a surprise that more second-cycle students are undecided on this point (Fig. 2).
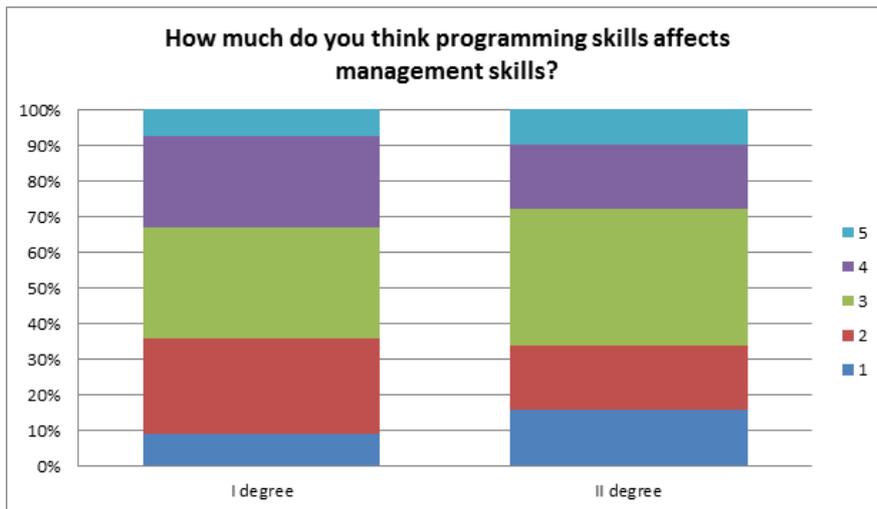
Fig. 2. Survey results to assess how much programming skills affects management skills at different study degrees.

Source: own study (N=121)

Second-cycle students do not participate in programming courses. If their previous studies also did not include such a course, they may have difficulty seeing the relationship between programming, including the development of algorithms and procedures, and management. It would be desirable to supplement the study program in this area.

In connection with the above answers, a question was asked about the usefulness of programming skills in everyday life. As it turns out, very similar results were obtained (Fig. 3).
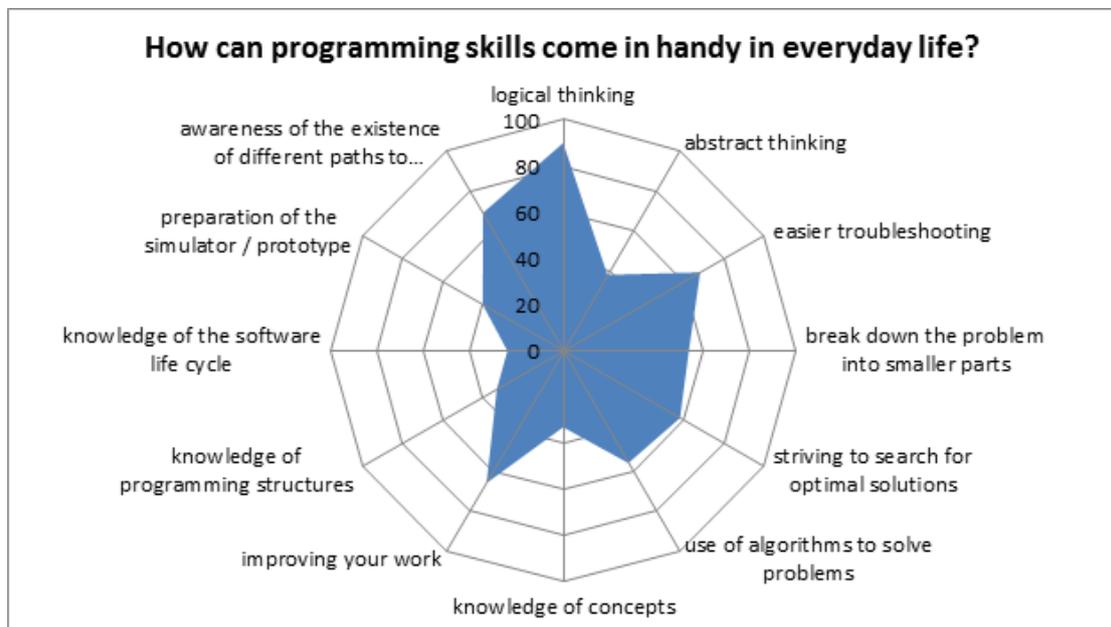

Fig. 3. Survey results to assess usefulness of programming skills in everyday life.

Source: own study (N=121)

The highest rated skill was logical thinking, which received the maximum score of 100%. This means that most respondents consider this competence to be crucial, especially when it comes to everyday problem-solving and decision-making. Equally highly rated were skills such as easier problem-solving and dividing larger problems into smaller parts. Respondents emphasized that these abilities, resulting from learning programming, allow for a more systematic and structured approach to everyday challenges.

In turn, skills related to searching for optimal solutions and using algorithms to solve problems were rated slightly lower, but still considered important. This indicates that although they are helpful in everyday life, their practical application is not as common as more general skills such as logical thinking.

Other competencies, such as awareness of the existence of different paths to solving a problem and improving one's own work, were also considered useful, although not as crucial as the previous skills. More advanced technical skills, such as knowledge of the software life cycle, preparation of simulators or prototypes, and knowledge of programming structures, turned out to be the least important in the context of everyday life. These skills, while valuable in programming jobs, are not often seen as necessary in everyday situations. Overall, the study results indicate that learning to program primarily provides transferable skills, such as logical thinking and problem-solving, that are valued in everyday functioning, while more technical aspects of programming play a lesser role.

In comparison with previous studies, our findings diverge from research on STEM students, where programming is consistently identified as a core enabler of analytical and managerial capabilities (Kalelioğlu et al., 2014; Psycharis et al., 2017). For management students, however, programming remains underappreciated in its direct contribution to managerial competences. This discrepancy may be linked to curriculum design, which often excludes practical programming experiences for non-technical students. At the same time, our results confirm insights from Hebebci et al. (2022) and Topsakal et al. (2022), showing that programming strongly supports cognitive skills such as logical and abstract thinking. Therefore, the discussion highlights that while programming's technical aspects are not yet fully integrated into management education, its transferable cognitive benefits provide an important foundation for everyday problem-solving and decision-making. This interpretation underscores the need for universities to bridge the gap between technical and managerial education.

Conclusion

The findings of this study demonstrate that programming skills, while valuable in many technical contexts, are not widely perceived as significantly enhancing management competences among the respondents. Only 30% of participants rated programming as positively influencing their managerial skills, with a mere 8% giving it the highest score. This indicates a relatively low recognition of the direct impact that programming knowledge, such as algorithm development and procedural thinking, can have on management practices. The results also highlight a lack of distinction between first-cycle and second-cycle students' perceptions, with second-cycle students being even more undecided on this topic, possibly due to the absence of programming courses in their curriculum.

However, the survey revealed a strong appreciation for the role programming skills play in everyday life. Logical thinking, problem-solving, and the ability to break down complex tasks into smaller, manageable parts were highly rated, indicating that the cognitive benefits derived from programming are recognized as valuable in daily decision-making and problem-solving. Skills such as searching for optimal solutions and applying algorithms were considered helpful, but less commonly utilized in everyday situations. More technical competencies, such as knowledge of the software life cycle or programming structures, were deemed less relevant outside of specific professional contexts.

These findings suggest that while programming may not yet be fully integrated into management education or widely recognized as a tool for developing managerial competences, it offers significant cognitive benefits that can be applied to both professional and everyday problem-solving tasks. There is an opportunity to better incorporate programming-related skills into management education, helping students understand the broader relevance of these skills in organizational decision-making and strategic thinking. Future research should explore how programming can be more effectively connected to managerial development, potentially through curriculum enhancements that demonstrate the practical applications of algorithmic thinking in leadership and organizational contexts.

Acknowledgment

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