

Exploring Computer Science Understanding and Rationales in Preservice Teacher Pathways through Faculty Professional Development

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Abstract: The demand for K-12 computer science education (CSed) is ever-increasing as technology permeates every aspect of society. Consequently, the need for well-prepared preservice teachers equipped with fundamental computer science knowledge has become paramount. Teacher education faculty play a critical role in the integration of CSed within preservice teacher training programs. However, there remains a significant knowledge gap regarding effective strategies for supporting faculty in this integration. This paper presents findings from a case study of a two-day, six-hour professional development initiative aimed at enhancing faculty understanding of computer science pedagogy and fostering integration rationales into preservice teacher education curricula. The study reveals that faculty emerged with a more nuanced understanding of CSed and diminished misconceptions conflating CS with general technology use. Furthermore, while rationales for integrating CSed varied, themes of access and equity emerged as central motivators across faculty perspectives, emphasizing the importance of CSed in preparing inclusive and equitable educational environments.

Keyword: CSed, Professional Development

I. INTRODUCTION

As technology continues to evolve, the role of computer science education in K-12 settings has gained prominence. Recognizing the necessity of equipping future educators with sufficient computer science knowledge, educational stakeholders are increasingly focusing on enhancing the capacity of teacher education programs to address this need. Faculty members in teacher education programs are pivotal in this initiative, as they shape the curriculum and provide preservice teachers with the requisite skills and understanding of computer science.

Despite the significance of this integration, there is limited empirical research addressing the strategies that effectively support faculty in embedding CSed within their coursework. This study aims to explore faculty's understandings of computer science through a targeted professional development program and to investigate the rationales faculty members employ when considering the integration of CSed in their teaching.

A. Literature Review

The existing literature on teacher education and professional development underscores the need for robust support structures to foster the integration of computer science into preservice teaching (Yadav et al., 2016). Research highlights the misconceptions that educators often have regarding computer science as a subject distinct from general technology use (Grover & Pea, 2013). Disparities in understanding can hinder successful implementation, making faculty professional development a critical avenue for addressing these issues. Additionally, themes of access and equity have emerged in discussions about the importance of CSed, suggesting that fostering inclusive practices in CS pedagogy is essential (Margolis et al., 2017).

B. Methodology

To thoroughly investigate the effects of the professional development initiative, a qualitative case study approach was systematically adopted. This professional development program spanned two days and involved six hours of instructional time, targeting a cohort of 49 faculty and staff members within a college of education. Out of this group, 21 participants agreed to participate in the study, willingly providing their insights and reflections on the program.

Data collection for this study was multifaceted and included a combination of pre- and post- development surveys, focus group discussions, and individual interviews. These methods were carefully chosen to effectively capture any

significant shifts in faculty understanding regarding computer science integration (CS integration) and to delve into the underlying rationales that informed their decisions surrounding this integration. By employing a range of qualitative data collection techniques, the aim was to achieve a comprehensive understanding of faculty perspectives and experiences pertaining to professional development in the context of computer science education (CSed).

The analytical framework chosen for this study was thematic analysis, which facilitated the identification of recurring patterns and themes within the faculty responses. This method enabled researchers to examine the nuances of faculty perceptions related to computer science education and to elucidate the reasoning behind their choices to integrate CS content into preservice coursework. By focusing on this framework, the goal was to uncover the complexities inherent in faculty understandings of computer science education, as well as the various motivations and factors that influenced their curricular decisions. Ultimately, the findings aim to contribute to a deeper understanding of how professional development impacts faculty attitudes and practices in the realm of integrating computer science into educational programming.

C. Findings

Nuanced Understanding of Computer Science Education

Recent data gathered following the post-professional development sessions revealed a noteworthy transformation in the way faculty members perceive and understand computer science education. The participants in the program demonstrated a marked enhancement in their comprehension of the field, illustrating a more nuanced perspective that distinguishes computer science from general technology use. This ability to differentiate between the two areas is a significant advancement, particularly in rectifying the misconceptions that have existed in the past, where the two concepts were often conflated.

Faculty members articulated their evolving views by expressing that computer science transcends the mere act of coding. They emphasized that it is, in fact, a comprehensive discipline that involves a variety

of fundamental elements, including but not limited to, problem-solving techniques, algorithms, and the principles of computational thinking. This broader understanding reflects a critical step forward in redefining and clarifying the scope of computer science education, allowing educators to convey its importance and relevance more effectively to students and the broader educational community. By fostering this deeper understanding, faculty members are better equipped to develop curricula and teaching strategies that truly represent the richness and complexity of computer science, ultimately preparing students for a rapidly evolving digital landscape.

Varied Rationales for CS Integration

The reasons provided by faculty for the integration of computer science (CS) into preservice teacher education programs displayed a wide range of perspectives. Nonetheless, two predominant themes emerged from their discussions: access and equity. Faculty members unanimously recognized the critical importance of equipping future educators with a foundational understanding of computer science concepts. This knowledge is essential for fostering equitable access to technology-related opportunities, ensuring that all students, regardless of their background, have equal chances to succeed in an increasingly digital world.

Members of the faculty acknowledged the transformative potential of computer science as a powerful tool that can help bridge disparities created by the digital divide—a phenomenon that has historically limited access to technology and related opportunities for marginalized communities. They emphasized that by integrating computer science education into teacher preparation, future educators can be empowered to address these disparities and promote a more inclusive approach to technology in the classroom.

Moreover, the faculty's reflections highlighted a deeply ingrained belief that the incorporation of computer science education into teacher training not only enhances pedagogical practices but also strengthens a broader commitment to social justice. This integration enables preservice teachers to foster inclusive learning environments where all students, irrespective

of their socioeconomic background or prior exposure to technology, can actively engage with and benefit from technological advancements.

Such environments encourage creativity, critical thinking, and collaboration, ultimately preparing students to navigate and thrive in a tech-driven society.

In conclusion, the integration of computer science into preservice education is viewed as a crucial step towards equity in education. It equips future teachers not only with the necessary technical skills but also instills in them a profound responsibility to ensure that all students can access and utilize technology effectively. By doing so, they contribute to a more just and equitable educational landscape, where every student is afforded the opportunities to explore, learn, and innovate in the digital age.

D. Discussion

The findings from this study suggest that structured professional development can significantly enhance faculty understanding of computer science education and its pedagogical implications. The emergence of access and equity as critical rationales for CS integration aligns with broader educational goals of creating inclusive and equitable learning environments. Faculty's newfound clarity helps inform their instructional strategies and can positively influence the next generation of educators in their approach to computer science.

As educators anticipate the future landscape of education, fostering a comprehensive understanding and appreciation for computer science becomes imperative. Universities and colleges should prioritize ongoing professional development initiatives for faculty to bridge the gap between CS knowledge and effective teaching practices.

III. CONCLUSION

The integration of computer science education into preservice teacher pathways is a complex yet essential undertaking. This study contributes valuable insights into the ways professional development can foster faculty understanding and rational participation in CSed. By emphasizing access and equity as foundational rationales, faculty not only enrich their students' educational experiences but also contribute to a more equitable technological landscape. Ongoing research and professional development will be critical in sustaining these efforts and ensuring that preservice teachers are well-prepared to meet the challenges of the increasingly digital world

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