

Contribution format (Discussion, Workshop)

Enhancing Academic Staff Skills in Applied Programming: An Interdisciplinary Approach to Empowerment and Pedagogical Innovation

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Abstract: There is a recognized need for improving skill sets among academic staff within the fields of digital competence and sustainability. The present initiative addresses professional development for academic staff at higher education institutions, with particular emphasis on applied programming. Many educators face challenges when aiming to integrate programming into their existing courses, including a lack of training tailored to their diverse backgrounds and pedagogical needs. The project investigates how academic personnel can be empowered to integrate programming into relevant subject areas with the aim of improving student learning. The project aims to develop and implement a professional development program to enhance participants' programming skills, as well as identify barriers and opportunities for access to programming training. The chosen approach is to embed a course in programming within the framework of a personal project, of interest to the staff member, that depends on a deeper working knowledge of programming. The participants work on their project, and we provide the desired knowledge framework and provides support for the application of programming skills. Faculty development is a central aspect of the lifelong learning of educators of high interest particularly in technological fields where the development of new technologies is increasingly fast.

Keywords: Professional Development, Applied Programming, Higher Education, Digitalization, Innovative Teaching Strategies.

1 Introduction and Background

The aim of this project is to develop a program focusing on the professional development of faculty members in higher education institutions, specifically in the field of applied programming. The research will explore how digitalization and new pedagogical approaches can enhance the skills of academic staff across various fields to effectively integrate programming into their subjects. It seeks to equip educators with the capabilities necessary to meet the demands of a rapidly evolving technological landscape.

Faculty members in higher education have needs that current teaching practices in programming often struggle to meet. This can lead to noticeable gaps in programming skills (Martin et al., 2019; Shon et al., 2024). Research shows that current teaching methods often overlook the different academic backgrounds and teaching needs of educators, which can worsen the gaps even further (Martin et al., 2019).

The intersection of programming and domain-specific knowledge is critical when developing software solutions that effectively address real-world problems (Alami et al., 2022). Programmers who specialize in coding may not have a deep understanding of other domains. This requires them to familiarize themselves with the subject matter to effectively develop systems of the desired quality. Academics, on the other hand, often possess extensive domain knowledge, making them a valuable resource in software development. Their insights can significantly contribute to creating software that effectively addresses the specified requirements. By fostering collaboration between programmers and domain experts, organizations can enhance the quality and relevance of their software solutions.

Current educational practices can fall short in addressing the diverse academic backgrounds and pedagogical needs of faculty members, leading to gaps in programming competence. Research suggests that faculty development programs focusing on interdisciplinary and collaborative teaching approaches can improve instructional quality and student outcomes. Furthermore, there is a pressing need for ongoing professional development in both programming and modern pedagogical techniques that incorporate digital tools and innovative learning environments.

It is important to identify the specific challenges academics encounter when trying to improve their programming skills. Professional development programs that take a more interdisciplinary approach seems to be a way forward, as it involves academics in practical problem-solving pertaining to their own domain. Moreover, as educational institutions adjust to new technologies, efforts to promote inclusivity and fairness should be a top priority.

The chosen approach is to embed a course in programming within the framework of a personal project, of interest to the staff member, that depends on a deeper working knowledge of programming. Prior to the course we engage with the participants to explore and identify which knowledge frameworks and skill sets are relevant to their projects and design the embedded course according to their needs, ensuring that the course content is both coherent and of sufficiently high quality. The participants work on their project while we provide the desired knowledge framework and provide support for the application of programming skills.

1.1 Objectives

The main objectives of the project are:

1. Create and implement professional development courses that enhance the programming skills of faculty members, ensuring that they are equipped with the latest knowledge and teaching methodologies relevant to applied programming.
2. Investigate the barriers and enablers affecting faculty access to programming training, focusing on their experiences and the resources available in their institutions.
3. Collaborate with various faculties in educational institutions to develop and implement innovative teaching strategies that enhance faculty engagement and improve student learning outcomes in applied programming courses.
4. Analyze how improving faculty competencies in applied programming can contribute to the overall quality of education, reinforcing the commitment to creating an inclusive and equitable learning environment in higher education.

By addressing these knowledge needs and objectives, the project aims to advance the quality of programming education, ultimately benefiting academic staffs' preparedness in a rapidly changing digital landscape.

1.2 Research questions and hypotheses

The primary research questions for the project are as follows:

1. What are the current competency gaps among faculty members teaching applied programming in higher education?

Hypothesis: Faculty members lack certain technical and pedagogical skills necessary for effectively applying programming in their teaching in an evolving digital landscape.

2. How do different professional development programs influence faculty competencies in applied programming?

Hypothesis: Interdisciplinary and practical-based professional development programs significantly enhance faculty's programming skills and teaching effectiveness.

3. What innovative pedagogical strategies best engage participants in applied programming courses?

Hypothesis: Incorporating academic staff's subject knowledge along with active learning techniques and collaborative projects positively impacts their engagement and learning outcomes in applied programming.

2 Theoretical Approach and Methodology

An interdisciplinary approach is essential to this project as it merges insights from educational pedagogy, specifically adult learning and andragogy, and computer science, along with participants' diverse domain knowledge. This triangulation facilitates the design of relevant and effective professional development programs that directly address the unique needs of educators in academia, and foster the competencies required in various academic fields.

2.1 Novelty and ambition

The research project intends to establish a comprehensive and innovative competency framework specifically designed for faculty teaching applied programming in higher education. This framework will integrate contemporary digital technologies, interdisciplinary teaching strategies, and engagement techniques that have yet to be cohesively represented in current pedagogical literature.

By adopting an interdisciplinary approach that combines insights from educational pedagogy and computer science, as well as participants' diverse domain knowledge, the research project should contribute new theoretical perspectives on how programming education can be effectively integrated into a broader curriculum.

The research project expands the traditional objectives of programming education by placing a strong emphasis on faculty development to enhance student learning outcomes. Recognizing the educator as a pivotal factor in the learning environment is a step toward addressing systemic challenges present in current programming education.

The use of a mixed-methods research design which combines qualitative interviews and quantitative surveys should enable a more holistic understanding of the needs and challenges of the faculty members. This not only enriches data collection but also allows for triangulation of results to validate findings and enhance the credibility of the research outcomes.

Addressing sustainability and ethical implications of applied programming education will be an important aspect of the research project. By considering these elements in the development of curriculum and faculty training programs, the research project aims to enhance the understanding of ethical practices and social responsibility in education, addressing important issues relevant to today's technological landscape. The research project demonstrates considerable potential for developing new knowledge and advancing theories, methodologies, and empirical understanding in the context of applied programming in higher education. The ambitious objectives and innovations outlined the position of the research project at the forefront of efforts to rejuvenate programming education and enhance the competencies of educators within this essential field.

2.2 The impact

The objectives and innovations presented in this research aim to tackle pressing challenges in applied programming education within higher education institutions. By focusing on developing comprehensive competency frameworks, interdisciplinary training for faculty members, and innovative pedagogical strategies, the research project is positioned to generate valuable outputs that can significantly impact the field of programming education. Specifically:

- The research project aims to fill existing gaps in pedagogical approaches and professional development among faculty based on empirical research that identifies specific educational needs. By providing data-driven solutions, the research project can enhance the quality of programming education, making it more relevant to today's digital landscape.
- The resulting competency frameworks and teaching strategies will offer higher education institutions structured guidance on faculty development. The outputs will be aimed at improving teaching effectiveness and participant engagement, thus addressing notable challenges in programming education.
- To ensure that the outputs are reproducible and potentially reusable, the research project will adopt open science practices. This includes:
 - The research project will manage all research data according to FAIR (Findable, Accessible, Interoperable, and Reusable) principles, ensuring that data sets are well-documented and accessible for future researchers.
 - Any publications, frameworks, models, and algorithms developed will be made available through open-access platforms to facilitate wider dissemination and engagement with the research community.
 - Comprehensive documentation of research findings and professional development strategies will be provided to ensure that others can easily adapt and implement the methodologies in their own contexts.

By focusing on these areas, the research project outputs are expected to contribute substantially to the scholarly discourse on programming education, ultimately leading to advancements within the research area.

While the primary focus is academic, the research project holds significant potential for societal impact, as it directly addresses issues related to educational equity and the skills gap in the workforce. The expected societal impacts are outlined below:

- The research project aims to provide effective solutions to the identified barriers in access to quality programming education. By enhancing faculty competencies, the research project directly contributes to better educational outcomes for participants from diverse backgrounds, promoting inclusivity and equal opportunity in technology education.
- Several of the research project's objectives intersect with specific UN Sustainable Development Goals (SDGs), particularly:
 - SDG 4: By improving teaching practices and fostering an inclusive learning environment, the research project aims to ensure equitable access to quality education in programming.
 - SDG 8: By equipping participants with essential programming skills, the research project contributes to a more skilled workforce, thereby enhancing employability and driving economic growth in the technology sector.
- The research project will prioritize communication with relevant stakeholders, including educational institutions, and policymakers. Through forums, workshops, and publications, the research project aims to share findings and best practices, further amplifying the societal impact of its research outputs.

The research project is designed to not only advance academic knowledge but also address significant societal challenges, promoting sustainable educational practices and contributing to broader societal goals.

3 Bibliography

Alami, A., Madsen, C. Ø., & Krancher, O. (2022). Spotlight on the Positives: How Do Information Technology Projects Achieve Cost Underruns? *HICSS*, 1–10.

Martin, F., Budhrani, K., Kumar, S., & Ritzhaupt, A. (2019). Award-winning faculty online teaching practices: Roles and competencies. *Online Learning*, 23(1).

<https://doi.org/10.24059/olj.v23i1.1329>

Shon, S., Shin, H., Rim, D., & Jeon, H. (2024). Nursing faculty development program for digital teaching competence. *BMC Medical Education*, 24(1).

<https://doi.org/10.1186/s12909-024-05453-8>