

From Bits to Bots: Prototype Coding as a Catalyst for Novice Programmers

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Abstract:

Learning fundamental programming concepts poses significant challenges, particularly for novice students without computer-related exposure. This mixed methods study investigates the effectiveness of prototype coding (build–code–test) in enhancing the computer programming learning experience. The research question guiding this work is: How do students experience learning to program through prototype coding? A series of hands-on workshops were conducted at a university in KwaZulu Natal, South Africa, using an experiential learning approach. The study involved 75 participants, predominantly first-year students with little to no prior programming experience. Data was collected through multiple sources: a Likert scale survey to gauge student perceptions, focus group interviews to gather in-depth insights, and observations from a series of ongoing workshops to track progress over time. Results indicate that incorporating prototype coding, such as using sensors and microcontrollers, facilitates the gradual development of programming skills. The tangible nature of prototypes proved beneficial in reinforcing abstract programming constructs, allowing students to visualize the direct results of their code in physical actions. This approach bridges the gap between theoretical knowledge and practical application, making complex concepts more accessible and engaging for novice programmers. These findings suggest promising avenues for developing innovative, physically manipulative programming education approaches. By integrating hands-on, prototype-based learning into curriculum design, educators may be able to create more effective and engaging programming courses, potentially improving student outcomes and retention in computer science programs.

Keywords:

Coding, Computer Education, Prototype, Experiential learning, Novice programmers, Microcontrollers.