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Digital Learning, Real Experiments: Preparing Students for Laboratory Practice

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Abstract

Preparing students for safe and effective work in a materials laboratory requires connecting theoretical knowledge with material-specific process decisions, equipment operation and safety requirements. This project aims to replace the existing written laboratory manual with an interactive digital learning environment offering opportunities to rehearse procedures and assess understanding. The centra question is how digital preparation can support independent learning and readiness for practical laboratory tasks. Flexible access enables students to learn at their own pace, revisit content and take responsibility for their preparation. This contribution presents the pedagogical design and prototype development of a browser-based learning environment. Development draws on existing laboratory manuals, teaching materials, equipment information and images of the physical laboratory. The design combines spatial orientation with interactive, simplified 3D equipment models. Action-oriented tasks are intended to help students apply subject knowledge to specific decision-making situations while considering safety requirements. Immediate feedback explains errors and guides subsequent actions. Additional knowledge questions support self-assessment and help students evaluate their understanding. Digital preparation and laboratory practice are designed as successive, connected learning phases. Students first rehearse selected procedures in the virtual environment before conducting and evaluating experiments in the physical laboratory. A planned evaluation involving students will examine the clarity of the learning content, usability and perceived learning benefits. Their feedback will inform the further development of the learning environment.

Keywords: Formative feedback; Interactive learning environment; Laboratory education; Procedural knowledge; Self-directed learning