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Digital Innovation and the Didactic Transposition of Biological Science: A Moodle-Based Approach to Mineral Nutrition Learning in Moroccan High Schools

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Abstract

This study explores how digital resources can support didactic transposition and compensate for infrastructural limitations in the teaching of mineral nutrition in Moroccan high schools. Persistent conceptual challenges have been documented among 1st Year of the Experimental Sciences Baccalaureate Program students, particularly regarding root absorption, ion transport, and nutrient assimilation. Diagnostic data from teacher questionnaires and student evaluations reveal that these difficulties are partly rooted in the gap between scientific knowledge and its reformulation in curriculum materials and classroom practices.

To address these issues, a prototype Moodle-based learning environment was developed, integrating interactive H5P modules, multimedia resources, guided inquiry tasks, and formative assessments. Grounded in didactic transposition theory, the course sought to bridge the distance between scholarly biological knowledge and its pedagogical reinterpretation, while offering alternative learning pathways where laboratory infrastructures are limited.

The intervention was implemented with high school learners, and its effects were assessed by comparing pre- and post-instruction performance. Preliminary results highlight a marked improvement in students' conceptual understanding of root structure–function relationships and ion uptake mechanisms. Teachers also reported higher learner engagement, improved clarity in conceptual representation, and greater autonomy thanks to digital access.

These findings suggest that digital platforms can help mitigate obstacles linked to limited laboratory conditions and didactic distortion, while promoting active learning in biological sciences. This work contributes to ongoing reflections on curriculum alignment, pedagogical innovation, and teacher professional development. It also offers implications for curriculum designers and policy makers seeking

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to integrate digital solutions in the Moroccan educational landscape.

Keywords: Active Learning; Biological Sciences; Blended Learning; H5P; Pedagogical Innovation