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INTRODUCTION

Knowledge can be acquired from a series of perspectives, mainly: “know-what” (concept), where facts and descriptions of (natural or social) phenomena are pursued; “know-how” (procedure), where methods and procedures for their application are described; and “know-why” (competence), where general principles and laws that explain both the facts and their applications are sought. The depth of student’s acquired competences will be directly affected by the teaching-learning perspective, traditionally aiming to a “know-why” approach. In this work, we discuss a suitable teaching-learning methodology for evaluating whether a “know-how”, a “know-what” or a combined approach is better for enhancing competence learning.

KNOWLEDGE

Acquisition

Accumulation (concepts / skills): pre-Bologna process

Application with a strategy (competences):
- European Higher Education Area (after Bologna process)

TRANSITION: new teaching-learning paradigm

Types

Know-What: concepts, facts and descriptions.
Know-How: skills, procedures and methods.
Know-Why: competences, theories and experimentation.

Know-What
- Learning-by-using
  - Concepts.

Know-How
- Learning-by-doing
  - Skills.

Know-Why
- Learning-by-studying
  - Competences.

CHEMISTRY LEARNING

Approach

Surface learning (Know-What):
- Mere reformulation of concepts.
  - Lack of chemical principles understanding.

Deep learning (Know-Why):
- Elaborated reasoning.
  - Causal relationship between phenomena.

Instructional Model

POGIL
- Process Oriented Guided Inquiry Learning

PBL
- Problem-Based Learning

PROBLEM-BASED LEARNING MODEL

Problem Levels

A. Control groups:

Group 1 (bottom-up):
- Know-What (concepts) → Know-Why → Know-How (project)

Group 2 (top-down):
- Know-How (project) → Know-Why → Know-What (concepts)

TEACHING PROTOCOL

Assessment tool: STUDENT’S PORTFOLIO

Problem Levels

LEVEL I
Know-What
- Elements: One concept.
  - Context: known.
  - Strategies: One, known.
  - Examples: short-answer questions, true-false, multiple choice.

LEVEL II
Know-Why
- Elements: One method and concept.
  - Context: unknown.
  - Strategies: Many, known.
  - Examples: exercises, conceptual derivations.

LEVEL III
Know-How
- Elements: Many methods and concepts.
  - Context: unknown.
  - Strategies: Many, unknown.
  - Examples: open-ended problems, projects.

CONCLUSIONS

- A protocol for assessing which type of knowledge is more appropriate for competence acquisition (“know-what” -concepts-, “know-how” - procedures- or “know-why” -competences-) is proposed.
- In a class, two control subsets are defined: bottom-up learning (Group 1, from “know-what” to “know-how”) and top-bottom learning (Group 2, from “know-how” to “know-what”).
- A 3 course assessment is proposed to study the student’s maturity effect on competence learning, where the weight of “know-how” is progressively increased.