
D. Monllor-Satoca, T. Lana-Villarreal, P. Bonete Ferrández, R. Gómez Torregrosa

Departament de Química Física, Universitat d'Alacant, Apartat 99, E-03080 Alacant, Spain (E-mail: damian.monllor@ua.es)

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.

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
- Problem-Based Learning

Instructional Model (POGIL, PBL)

(1) Scientific questioning
(2) Explore and create explanations
(3) Provide and connect explanations with prior knowledge
(4) Extend, apply and evaluate what has been learned

Problem-Based Learning Model

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.

Teaching Protocol

A. Control groups:

Group 1 (bottom-up):
- Know-What (concepts) → Know-Why → Know-How (project)
- Assessment tool: STUDENT’S PORTFOLIO

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

B. Multi-course assessment:

1st course: What (50%) → Why (50%)
2nd course: What (30%) → Why (50%) → How (20%)
3rd course: What (10%) → Why (40%) → How (40%)

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.