Conceptual and Procedural Learning

Readiness
Individual
Algebra:
Teaching of
Supporting

CONCEPTUAL KNOWLEDGE

"knowledge rich in relationships"

"a connected web of knowledge in which the linking relationships are as prominent as the discrete pieces of information"

PROCEDURAL KNOWLEDGE

"familiarity with the individual symbols"

"rules or procedures for solving mathematics problems"

Conceptual knowledge often supports and leads to procedural knowledge.

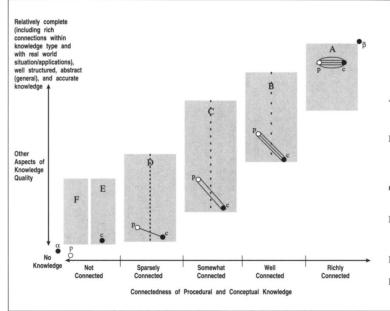
Children's conceptual knowledge can help them invent and understand procedures.

(Rittle-Johnson et al., 2015, p. 588)

Evidence indicates the relations between conceptual and procedural knowledge are **bidirectional**, with improvements in procedural knowledge often supporting improvements in conceptual knowledge and vice versa.



(Rittle-Johnson et al., 2015, p. 594)



Type of knowledge

 $p \circ = Procedural knowledge$

 $^{c} \bullet = Conceptual knowledge$

Diagonal $\alpha\beta$ = depth of knowledge α = No knowledge β = (Momentary) maximum deep knowledge

- A = Extensive adaptive expertise—deep procedural and conceptual knowledge (fully integrated strong schema and schemes)
- B = Less extensive adaptive expertise—relatively deep procedural and conceptual knowledge (somewhat integrated, relatively strong schema and schemes)
- C = Transition between relatively shallow and relatively deep procedural and conceptual knowledge
- D = More routine than adaptive expertise—relatively shallow procedural and conceptual knowledge (relatively weak scheme and schemas)
- E = Routine expertise of (shallow) conceptual knowledge (weak schema)
- F = Routine expertise of (shallow) procedural knowledge (weak scheme)

in a domain requires knowledge of both concepts and procedures.

(Rittle-Johnson et al., 2001, p. 359) Rittle–Johnson, Siegler, & Alibali (2001)

Hiebert & Lefevre (1986)

Rittle-Johnson, Schneider, & Star (2015)

Baroody, Feil, & Johnson (2007)