EVIDENCE-BASED INSTRUCTION STRATEGIES TO IMPROVE DRUG CALCULATION SKILLS

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INTRODUCTION

- Medication errors and insecure practices harm healthcare systems worldwide.
- Each year, around 7,000 to 9,000 people in the United States die due to medication errors. (Tariq et al., 2023).
- There is no standardized method of educating healthcare providers on medication calculations.

OBJECTIVES

Identify evidence-based instruction strategies for drug calculation skills development and describe the strategies based on the research-based principles for smart teaching.

METHODOLOGY

- Evidence-based systematic review, using Whittemore and Knalf (2005) steps:
  (1) defining the research question,
  (2) conducting a literature review,
  (3) gathering data from primary sources,
  4) analyzing data, and
  (5) presenting findings.
- Databases: CINAHL, PubMed, and PsycINFO
- Search terms: "students," "nursing," "education," "drug dosage calculations," and "mathematics."
- Inclusion criteria: include nursing students or nurses, be written in English, and not restricted in regards of the country. Articles were not restricted to any one country because medication calculation errors related to patient safety remain a significant global issue.
- From 2014 to 2020, a total of 1793 articles were retrieved.

RESULTS

- Total: 51 studies.
- Majority reported:
  Levels of evidence: III (23.5%) and V (41.2%).
  Quality of evidence: Level B (82.4%).
- Major teaching strategies were early diagnostic assessments of students' knowledge, anxiety, and self-confidence; stimulate self-directed learning, and working on knowledge organization by scaffolding complex tasks, and being explicit about objectives and expectations.
- The use of e-learning has become increasingly popular since 2018.

RESULTS

Table 1. Studies characteristics

		Frequency	Percent	Cumulative Percent
Levels of Evidence[1]	II	2	3.9	3.9
	III	12	23.5	27.5
	IV	6	11.8	39.2
	V	21	41.2	80.4
	VII	7	13.7	94.1
	VIII	3	5.9	100.0
Quality of evidence[2]	A	3	5.9	5.9
	B	42	82.4	88.2
	C	6	11.8	100.0
Roles of evidence[3]	1	20	39.2	39.2
	2	24	47.1	86.3
	3	7	13.7	100.0

[1]**Hierarchy of evidence:** I-Systematic review/meta-analysis of Randomized Controlled Trials (RCTs), II-Randomized Controlled Trial (RCT), III-Nonrandomized trial (quasi-experiment), IV-Systematic review of nonexperimental (observational) studies, V-Nonexperimental/observational study, VI-Systematic review/metasynthensis of qualitative studies,VII-Qualitative study/descriptive study, VIII-Nonresearch source (e.g. internal evidence, expert opinion). Source:(Polit & Beck, 2022)
[2]**Quality of evidence:** A-Strong, B-Good, C-Weak. Based on methodological quality of their design and report (COREQ, PRISMA, STROBE). Level A: Level I evidence or consistent findings from multiple studies of levels II, III, IV, or V; Level B: Levels II, III, IV, or V evidence and findings are generally consistent; Level C: Levels II, III, IV, or V evidence with inconsistent findings or there is little to no systematic empirical evidence. The grading system assists in decision-making and does not degrade lower-level evidence when deciding recommendations if the results are consistent. Level C indicates possible areas for future research as they reveal briefly explored or conflicting findings.
[3]**Role of evidence:** (1) establishing current students' learning status; (2) choosing appropriate teaching and interventions approaches; and (3) monitoring student progress and evaluating teaching effectiveness. Source (Masters, 2018)

Table 2. Smart teaching principles addressed in the studies reviewed

Smart teaching principles[1]	N(%) (N=51)
Prior knowledge can help or hinder learning	20(39.2%)
Knowledge organization influences how students learn and apply what they know	14(27.5%)
Student's motivation determines, directs, and sustains what they do to learn	7(13.7%)
To develop mastery, students must acquire component skills, practice integrating them, and know when to apply what they have learned	12(23.5%)
Goal-directed practice coupled with targeted feedback enhances the quality of students' learning	11(21.6%)
Student's current level of development interacts with the social, emotional, and intellectual climate of the course to impact learning	9(17.6%)
To become self-directed learners, students must learn to monitor and adjust their approaches	17(33.3%)

[1]**Source:** Ambrose, Bridges, DiPietro, Lovett, & Norman, 2010.

CONCLUSION

- Technology benefits education by complementing in-class practice and providing students with opportunities for creative, autonomous, collaborative, and interactive learning.
- In recent years, there has been an increase in publications utilizing e-learning, smartphone apps, and web pages to improve drug calculation skills (for example: https://www.safemedicate.net/ and https://testandcalc.com/index.html).
- However, due to the low levels and quality of evidence, we recommend that future studies use research designs that produce higher levels of evidence.
  - Ex: Randomizing teaching methods per semester enhances consistency in monitoring student progress and evaluating teaching effectiveness.
  - Implementing web-based software can also support effective research-based approaches.
- Recommendation: teaching approaches should address cognitive, motivational, and developmental goals to ensure student success.
- Future trends are adaptive web-based technology aiming at improving the learning of medication calculation skills (Ravik & Andresen, 2023).

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REFERENCES

Ambrose, S.A., Bridges, M.W., DiPietro, M., Lovett, M.C., Norman, M.K., 2010. How learning works: Seven research-based principles for smart teaching. John Wiley & Sons.
Ravik, M., & Andresen, K. R. (2023). Adaptive Web-Based Technology Aiming at Improving Learning of Medication Calculation Skills for Nursing Students.
Tariq RA, Vashisht R, Sinha A, et al. Medication Dispensing Errors and Prevention. [Updated 2023 May 2]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/boo

Scan here for access to detailed instruction strategies (Table 2) and the article at Nurse Education Today: