RESEARCH

Methods for Optimizing Student Pharmacist Learning of Clinical Note Writing

Karl Kodweis, PharmD,a Liza C. Schimmelfing, PharmD,a YanYing Yang, PharmD,a Adam M. Persky, PhDab

a University of North Carolina at Chapel Hill, Eshelman School of Pharmacy, Chapel Hill, North Carolina
b Associate Editor, American Journal of Pharmaceutical Education, Arlington, Virginia

Submitted May 15, 2020; accepted November 4, 2020; published February 2021.

Objective. To investigate the effectiveness of using problem-solving and worked examples in teaching clinical note writing to Doctor of Pharmacy students.

Methods. First year student pharmacists who were recruited to participate in the study first studied a worked example on generating a clinical note from a written patient case. Participants were then randomized either to study another worked example or to practice writing a clinical note from a written patient case. Embedded in each condition was problem variability (ie, participants encountered either a similar disease state as that in the initial worked example or a different disease state). The primary outcome was the combined performance on writing two clinical notes. Secondary outcomes included quiz performance on knowledge of the components of a clinical note and ability to transfer writing skills to a novel disease state.

Results. Seventy-nine students completed the study. Participants who studied a worked example followed by problem-solving (WE-PS) practice performed better than participants who studied two worked examples (WE-WE) on clinical note writing. However, there was no difference in their respective knowledge as determined by quiz performance.

Conclusion. Both worked examples and problem-solving facilitated students’ learning of the basic knowledge of clinical note writing. However, only problem-solving improved student pharmacists’ ability to apply that knowledge. While there were significant improvements in student pharmacists’ knowledge of the basics of clinical note writing, it is unclear how worked examples or problem-solving influence the clinical decision-making skills needed to write a clinical note.

Keywords: worked examples, retrieval practice, transfer, clinical note, SOAP note

INTRODUCTION

When students are learning to solve problems, two important instructional strategies are commonly used: studying a worked example and practicing problem-solving. A worked example is a step-by-step explanation or demonstration on how to solve a particular problem or situation.1 If a student was asked to solve for x given the equation 2x + 10 = 24, then the worked example would take a stepwise approach to show the solution (eg, Step 1: subtract 10 from both sides; Step 2: divide both sides by 2).1 Problem-solving practice is retrieving information from one’s memory to solve a given problem. For example, after a lesson on basic algebra, a student may be asked to solve the same problem, 2x + 10 = 24, on their own, without any guidance.

Selection of instructional strategies can be difficult and is often contextual. For instance, when a first-year medical student is learning to perform a procedure, problem-solving practice (eg, retrieval practice) may be the most effective method of instruction because retrieval practice strengthens the student’s memory of the fixed sequence of steps required for the procedure. However, for acquiring and developing the initial cognitive framework to organize the key concepts of the procedure, a more effective approach may be a worked example. This instructional strategy has been used for areas of problem-solving that are more algorithmic, such as math, physics, or computer programming, but have not often been applied to less-algorithmic activities such as writing.1 Because clinical note writing requires a procedure for breaking down a patient case into defined
The task of clinical note writing may be very adaptable to these instructional approaches. As such, we examined two approaches to teaching clinical note writing: a worked example paired with problem-solving practice (WE-PS) and a worked example paired with another worked example (WE-WE). The differences between utilizing a worked example versus problem-solving for writing a clinical note are illustrated in Figure 1.

With regards to problem-solving, an individual must first have a schema. Schemas are generic knowledge frameworks with respect to a specific situation that guide recognition and understanding of a new problem. A schema can help in the problem-solving process by helping learners recognize the problem structure. Acquisition of a schema may be improved by providing learners with worked examples. Providing novices with more worked examples is often more effective for learning than relying heavily on problem-solving practice; however, once a schema is acquired, problem-solving practice may be more beneficial. Studies have found that students provided with worked examples outperformed students who used problem-solving practice. These findings contrast somewhat with the generation effect, which states that people are better able to recall information that they generate themselves. In certain instances (especially for novices), the benefits of worked examples may outweigh the benefits of learning by problem-solving. However, it is unclear how easy it is to develop the schema necessary for clinical note writing. If easy, the worked example-problem-solving approach may prevail; if difficult, the worked example-worked example approach may be best. Research suggests that studying additional worked examples may be more effective than solving additional problems in learning a procedure like clinical note writing.

In addition to the problem-solving domain, learners must also develop the ability to transfer their skills to new problems. Few studies have compared the effects of only worked example study to only problem-solving study. Of these, some found no difference and some found a benefit from problem-solving, but most found that worked examples were more effective for transfer. Most studies, however, have alternated worked examples with problem-solving (example-practice approach). Several studies have shown that worked example and problem-solving pairs were more effective for learning and transfer than

![Worked Example](Image)

**Case Vignette**

**Generic Format**

The worked example explained each section of the SOAP note. Then there was a vignette like that seen in the problem-solving scenario (on right). The call out boxes (in gray) explained how that section of the case was translated into the SOAP note.

**Example**

Following referral from PCP, CW presents to UNC Family Medicine Clinic for management of hypertension (HTN).

---

**Problem Solving**

**Case Vignette**

Patient Name: Charlene Whittaker
MRN: 73302-1123
DOB: 6/23/1977

CW presents, following referral from PCP, to UNC Family Medicine Clinic for management of recent hypertension. Last June 2018, she presented to her Primary Care Physician for her a wellness checkup. At the most recent visit, CW’s blood pressure reading was 165/79 mmHg. During the 2 previous visits, CW has had consistently high blood pressure readings. As a result, she was initiated on atenolol following a diagnosis of hypertension. Past medical history includes seasonal allergies. Current medications include...

Construct a SOAP note for this patient.
problem-solving alone. However, when the results of studies examining worked example followed by worked example (WE-WE) were compared to studies where worked example was followed by problem-solving practice (WE-PS), the findings were mixed. Problem variability may also help with the ability to transfer skills and knowledge. Thus, we introduced problem variability to assess the impact on transferring clinical note writing to different disease states.

Some research studies have investigated different teaching methods on clinical note writing. Within these studies there was an emphasis on assessing the clinical notes written and less on teaching the actual skill of note writing. In one study, Andrus and colleagues investigated the implementation of a standardized rubric into a pre-existing practice for clinical note writing during advanced pharmacy practice experiences. Students who received formative feedback and further instructional direction had significant improvements in their scores and in their confidence in clinical note writing, and received more consistent grading from various preceptors. Divine and colleagues explored the impact of curricular integration on clinical note writing. Their study incorporated guided instruction, peer grading, and recorded simulations into their didactic courses to address an observed deficiency in clinical note documentation. The researchers found that these changes provided more opportunities to practice documentation skills, while producing significant improvements in the assessment and plan domains of the clinical note. While this research has shown improvements, there is limited data regarding the use of explicit instruction in teaching clinical note writing.

The purpose of our study was to investigate the role of worked examples and problem-solving practice in student pharmacists learning and reinforcement of the skills for writing a clinical note. Specifically, we tested the effectiveness of the worked example-problem-solving (WE-PS) approach against that of the worked example-worked example (WE-WE) approach to learning to write clinical notes. Furthermore, we examined the effects of variability on the worked examples or problem-solving practice, relative to initial learning and transferability skills.

**METHODS**

We used a 2x2 factorial study design to examine both instructional activity (worked example or problem-solving practice) and problem variability (low or high). The study design consisted of three phases: learning, intervention, and assessment (Figure 2).

An *a priori* sample size calculation was performed based on a large effect size (d=0.8), alpha of 0.05, and beta of 0.2. The sample size needed was 26 participants per group as determined using G*Power 3.1 software (Universität Kiel, Germany). Participants were recruited from the first professional year (P1) at one school of pharmacy, and the study was conducted during the first month of the PharmD program. First professional year students (P1) were selected because of the lack of any formal instruction on clinical note writing and minimal background in patient care. Participants were compensated with a $15 gift card. Students within the first professional year were similar in age (M=22 years, range 18-31 years) and educational background (91% with a college degree, mean grade point average=3.5, mean Pharmacy College Admission Test score=88%).

The first part of the study was conducted in a classroom where participants were given 90 minutes to complete the learning phase and intervention phase. Students were provided with a link to an online platform (Qualtrics) that contained all the study materials. In the learning phase, students worked individually to study a worked clinical note. Following this brief overview, a patient case was presented. The final task was
translating the patient case into a worked example. Here
the worked example explained and guided the partic-
ants on how to breakdown the case, in a step-by-step
fashion, into their respective clinical note domains (Fig-
ure 1). The first worked example was a patient with stage 2
hypertension and no other comorbidities. To account for
the P1 students’ limited clinical knowledge, they were
provided with abridged therapeutic guidelines, pertinent
to the patient case, to help them understand the relevant
drug therapy, dosing, and monitoring parameters. All case
vignettes and their solutions and worked examples were
developed by the authors and vetted by content experts
who taught in the respective therapeutic areas.

The intervention phase was conducted in the same
classroom, immediately after the first worked example
was completed. Participants were randomized into four
conditions by the online platform: worked example with
low problem variability; worked example with high
problem variability; problem-solving with low variabil-
ity, and problem-solving with high variability (Figure 2).
In the first two conditions, participants were presented
with and studied another worked example (WE-WE). For
the latter two conditions, participants were asked to
generate a clinical note (WE-PS). For the problem-
solving conditions, feedback was provided to students
upon submission of their practice problem by providing
them with the same worked example used in the other
conditions. Two other conditions were nested within
the WE-WE and WE-PS conditions. Half of the students
assigned to each condition (WE-WE or WE-PS) received
a second case about hypertension that represented low
problem variability because of the case’s similarity to the
initial case (stage 2 hypertension). The other half of
the students assigned to the WE-WE and WE-PS groups
received a case about type 2 diabetes that represented high
problem variability (Figure 2). For all participants, re-
gardless of the condition to which they were assigned,
backward navigation in Qualtrics was disabled so that
they could not go back to re-study the original materials
provided. Day one of the study concluded with the com-
pletion of the intervention (ie, second worked example or
the practice problem). As in the learning phase, students
were provided with abridged, relevant guidelines during
the intervention. Following day one, links were deacti-
vated and students could not review the experimental
material in preparation for the next phase.

Three days later, participants returned to the class-
room and began the assessment phase of the study. Con-
sistent with day one, participants were given 90 minutes
to complete the assessment. The assessment phase consisted
of students completing a quiz and generating two clinical
notes from vignettes. The quiz assessed the lower levels of
Bloom’s taxonomy (knowledge and comprehension) us-
ing a mixture of single best answer multiple-choice
questions and select-all-that-apply items. For the select-
all-that-apply items, participants received one point (+1)
for correct responses and lost one-half point (-0.5) for
incorrect responses. For each section of the clinical
(SOAP) note there was a definition question and select-
all-that-apply question regarding what information goes
into which sections (eg, family history into the S; labo-
atory values into O, and so on). Following the quiz, all
participants then completed two clinical notes, one for a
patient with stage 2 hypertension and another for a patient
with a Clostridium difficile infection. These two different
disease states were used to examine the ability of partic-
rients to transfer their skills near (to another hypertension
case) and far (to the C. difficile case). Clinical notes were
scored using a modified 25-point checklist based on the
American Pharmacists Association guidelines and
adopted from others. This modified checklist only
evaluated the presence or absence of material in each
section of the note rather than relevancy of the material
as that would have required participants to have more
clinical expertise.

The primary analysis was the participants’ average
performance on the two clinical notes (eg, hypertension
and C. Difficile) under the conditions of either worked
example or problem-solving. The secondary analysis was
the average performance on the two clinical notes under
conditions of low or high problem variability. We also
subsequently examined these conditions for the quiz
scores and performance on each note to examine trans-
ferability of skills. Each note was graded individually by
two assessors and any discrepancies were discussed until
consensus was achieved.

A p value of 0.05 was used as the threshold for sta-
tistical significance. A 2x2 ANOVA (worked examples/
problem-solving and low/high variability), with planned
comparisons using Bonferroni adjustment for three
comparisons when appropriate. Statistical calculations
were conducted using SPSS Statistics for Windows,
version 22.0 (IBM). We calculated an effect size, when
appropriate, using Cohen’s d with d ≤0.5 as a small effect,
0.5< d ≤0.8 as a medium effect, and d>0.8 as a large
effect. This study was approved by the University of
North Carolina Institutional Review Board.

RESULTS
Eighty-one P1 students were initially enrolled in the
study; however, only 79 remained through completion
(n=79, 98%). Two of the participants were excluded
because they provided incomplete data or did not finish all
components of the study.
The primary study outcome was the application of learning by generating two clinical notes, with the outcome measured being the average of these two notes. Participants who engaged in problem-solving practice (WE-PS) outperformed those who studied a second worked example (WE-WE) (WE-PS, 72%; WE-WE, 64%; difference -8% [95% confidence interval: -12%, -4%], p<.001, d=0.93) (Table 1). Specifically, differences were seen in performance on the subjective (d=0.79, p=.001), objective (d=0.64, p=.005), and plan (d=0.46, p=.04) sections, but not on the assessment section (d=0.28, p=.13; Table 1). When comparing low- to high-variability, we found no significant effects on note writing performance, except in the subjective section (d=0.48, p=.039) (Table 1). There were no interactions between instructional strategies and variability conditions (p=.83). Students randomized to the WE-WE group with low variability practice (65%, n=23) performed no differently in note writing than the WE-WE group with high variability (64%, n=19) (difference 1% [95% CI: -4%, 6%]). Students randomized to the WE-PS group with low variability practice (72%, n=14) performed no differently in note writing than the WE-PS group with high variability (72%, n=23) (difference 0% [95% CI: -7%, 7%]).

We assessed knowledge retention and comprehension via a quiz administered three days after the learning phase but no further reinforcement of learning was provided. The mean score on the knowledge quiz was 75%. However, there was no significant difference in quiz scores between participants who received the worked example and those who received the problem-solving practice conditions (Table 1). Additionally, there were no significant differences in quiz scores between the low- and high-variability groups (Table 1). There was no interaction on quiz score performance between learning strategy (worked example or problem-solving practice) and variability conditions (high or low).

We looked further at performance on individual cases to examine differences in the ability to transfer skills. Participants performed better on the hypertension case than on the C. difficile infection case (hypertension, 72%; C. Diff: 65%; difference, -7% [95% CI, -10%, -5%, p<.001, d=0.63), especially in the subjective (hypertension: 84%, C. Diff: 69%, p<.001, d=1.1) and assessment (hypertension: 50%, C. Diff: 39%, p<.001, d=0.5) sections. First, we examined near transfer of learning based on variability in the learning, ie, all students were presented with an example of a hypertension case; thus, we looked at performance on a hypertension case. There was no difference in overall performance between participants who were assigned two hypertension cases (low variability) and those who were assigned two different disease states (high variability) (Table 2). For far transfer, we observed performance on a novel case (C. difficile). No significant differences in transferability were observed between the low- and high-variability conditions (Table 2). However, participants who were given a practice sample performed better on both cases than those who completed two worked examples. In other words, the WE-PS group performed better on the near- and far-transfer tasks compared to students in the WE-WE group.

### Table 1. Quiz and Combined Clinical Note Performance as a Function of the Primary Outcomes of Instructional Methods (Worked Example or Problem-Solving) and Variability (Low and High) in Problems

|                   | Combined | Instructional Method | Variability |
|-------------------|----------|----------------------|-------------|
|                   |          | WE-WE (n=42) | WE-PS (n=37) | Low (n=37) | High (n=42) |
| Quiz              |          |              |              |            |             |
| Total             | 75 (12)  | 74 (12)     | 76 (12)     | 75 (12)   | 76 (13)   |
| S                 | 74 (15)  | 74 (13)     | 74 (16)     | 73 (14)   | 75 (15)   |
| O                 | 71 (16)  | 70 (16)     | 72 (16)     | 70 (16)   | 72 (16)   |
| A                 | 79 (25)  | 74 (30)     | 83 (18)     | 79 (24)   | 78 (27)   |
| P                 | 83 (19)  | 81 (21)     | 85 (16)     | 82 (21)   | 84 (16)   |
| Clinical Note     |          |              |              |            |             |
| Total             | 68 (10)  | 64 (8)      | 72 (9)a     | 67 (10)   | 69 (10)   |
| S                 | 77 (11)  | 73 (10)     | 81 (10)b    | 74 (12)   | 79 (9)b   |
| O                 | 77 (19)  | 71 (18)     | 83 (19)c    | 74 (21)   | 79 (17)   |
| A                 | 44 (18)  | 42 (17)     | 47 (19)     | 47 (15)   | 42 (20)   |
| P                 | 73 (14)  | 70 (13)     | 76 (13)d    | 73 (15)   | 73 (12)   |

Data shown as mean percent and standard deviation. Total refers to total score for the SOAP note and score is broken down by component pieces of the SOAP note: S – Subjective, O – Objective, A – Assessment, P – Plan. Combined is performance regardless of condition. WE-WE: worked example-followed by worked example approach, WE-PS: worked-example followed by problem solving approach

a Significantly different compared to worked example condition
b Significantly different compared to low-variability condition
DISCUSSION

This study examined the use of worked examples and problem-solving to facilitate the learning of clinical note writing. We found that giving students a worked example followed by a problem-solving example (the WE-PS approach) was superior to giving them a worked example followed by a second worked example (the WE-WE approach). The WE-PS model yielded higher student performance on both near- and far-transfer tasks. We did not find any variability in student performance or knowledge transfer when the cases used for each type of example were varied.

Our findings that the WE-PS approach was superior was consistent with the findings of Yeo and Fazio, who suggested that the use of problem-solving and worked examples aligns with the knowledge-learning instruction (KLI) framework. The KLI framework consists of both testing to support one’s goals for stabilizing facts (ie, problem-solving practice or retrieval practice) and reviewing worked examples if the goal is to learn flexible procedures (eg, schemas). In our model, we observed that flexibility in procedure was present in the problem-solving group with their ability to apply and transfer the task. Both groups received similar quiz scores, indicating they acquired the desired knowledge, but students’ ability to apply the knowledge learned from the worked example varied depending on the learning approach to which they were assigned.

The use of variable learning problems may support more durable learning of a procedure. Past studies have shown benefits of variable worked examples, while some have not. Researchers have proposed that presenting participants with two or more different worked examples supports transfer of learning by allowing students to link analogous solutions to different problems. In this study, we found no benefit of providing students with a variety of worked examples or practice problems. We focused on two nonidentical problems for practical reasons (time, realism to classroom practice). Providing students with additional nonidentical problems may impact the results. The use of multiple nonidentical problems may be more consistent with the effects of a curriculum where clinical notes are constructed for a variety of disease states over time.

A primary strength of this study was the use of learners who had not received prior formal instruction in clinical note writing on how to develop a set of essential, complex clinical skills. In addition, it is one of the few studies that has looked at using worked examples vs more formulaic problem-solving to teach clinical note writing. While worked examples and problem-solving seem to have helped students with learning the formulaic part of writing a clinical note (ie, what goes into the four sections of the SOAP note), clinical writing requires a basic level of therapeutic knowledge and exposure. In this study, we did not assess the appropriateness of the information or recommendations included in the examples, but rather whether the student provided the information in the appropriate sections of the SOAP note. The former requires clinical judgement, which is a limitation when using novice learners. For this reason, clinical note writing is usually taught in the context of therapeutics. For the therapeutic recommendation students’ proposed in their clinical note, the appropriateness of the included material was more straightforward since abridged guidelines were provided; that is, they could not recommend an alternative sub-optimal, therapy. The WE-WE approach may have been beneficial if pertinent information had been included in the grading rubric. The WE-WE approach may help with schema generation, instead of emphasizing the exact steps in a process. Additionally, because the sample size was based on large effect sizes, the study was not able to detect some of the small to medium differences that were observed (eg, when examining transfer effects). From a practical classroom intervention standpoint, this intervention allowed students to study once before assessing their abilities. In an authentic classroom, students would study the material repeatedly, which could improve performance.
This study also used a composite score from two different clinical notes crafted using the SOAP note format. Both the number of notes written and the format used may have been a strength of this study (i.e., multiple outcome measures and a clinically relevant format) or a potential limitation. Having study participants write only two clinical notes may be viewed by some as low sampling compared to studies in which an examination with multiple questions is administered. Given the large effect size, it is unlikely that requiring more clinical notes would have changed the outcome. As for format, the format used for writing clinical notes varies by institution as well as by practice setting. Some institutions may vary the structure (e.g., assessment and plan first), and some practice settings may only write a progress note and not a full note. Regardless of format, the skills required to write a clinical note following any format may be strengthened by studying worked examples and problem-solving.

The literature pertaining to instruction in clinical note writing is limited; thus, this study helps to augment our current understanding in this area. In addition, it also extends the previous findings around worked examples and problem-solving practice, which is typically focused on more algorithmic problems and math-based disciplines. By applying this literature to a less algorithmic task like writing, our findings augment the benefits of both worked examples and problem-solving. Further studies are needed to differentiate under what conditions the use of WE-WE or WE-PS is optimal, especially considering the role of clinical knowledge and the appropriateness of recommendations.

CONCLUSION

When the goal was for novice student pharmacists to generate a clinical note from information provided in a written case, the WE-PS approach was associated with better performance. When student pharmacists were asked to recall foundational knowledge about a clinical note on a quiz, there was no difference in retention of the content between those who had completed the WE-PS approach and those who had completed the WE-WE approach. The WE-PS model also was beneficial in helping students transfer their clinical note writing skills to a novel disease state. Hence, our findings suggest that use of the WE-PS approach provides optimal retention and transfer of knowledge when a procedure needs to be followed. Results from this study can help guide future instruction and provide insight into helping student pharmacists write clinical notes.

ACKNOWLEDGMENTS

This study was supported by a Scholarship of Teaching and Learning (SOTL) grant sponsored by the American Association of Colleges of Pharmacy (AACP) and the American Foundation for Pharmaceutical Education (AFPE).

REFERENCES

1. Hanham J, Leahy W, Sweller J. Cognitive load theory, element interactivity, and the testing and reverse testing effects. Appl Cogn Psychol. 2017;31(3):265-280.
2. Cooper G, Sweller J. Effects of schema acquisition and rule automation on mathematical problem-solving transfer. J Educ Psychol. 1987;79(4):347-362.
3. Kalyuga S, Chandler P, Tuovinen J, Sweller J. When problem solving is superior to studying worked examples. J Educ Psychol. 2001;93(3):579-588.
4. Tuovinen JE, Sweller J. A comparison of cognitive load associated with discovery learning and worked examples. J Educ Psychol. 1999; 91(2):334-341.
5. Ward M, Sweller J. Structuring effective worked examples. Cogn Instruct. 1990;7(1):1-39.
6. Kalyuga S. Expertise reversal effect and its implications for learner-tailored instruction. Educ Psychol Rev. 2007;19(4):509-539.
7. Renkl A. Toward an instructionally oriented theory of example-based learning. Cogn Sci. 2014;38(1):1-37.
8. van Gog T, Rummel N, Renkl A. Learning how to solve problems by studying examples. In: Dunlosky J, Rawson KA, eds. The Cambridge Handbook of Cognition and Education. New York, NY: Cambridge University Press; 2019:183-208.
9. Chechile RA, Soraci SA. Evidence for a multiple-process account of the generation effect. Memory. 1999;7(4):483-508.
10. Didierjean A, Cauzinille-Marmeche E. Eliciting self-explanations improves problem solving: what processes are involved? Cahier Psychol Cogn. 1997;16(3):325-351.
11. Carroll WM. Using worked examples as an instructional support in the algebra classroom. J Educ Psychol. 1994;86(3):360-367.
12. Mwangi W, Sweller J. Learning to solve compare word problems: the effect of example format and generating self-explanations. Cogn Instruct. 1998;16(2):173-199.
13. Rourke A, Sweller J. The worked-example effect using ill-defined problems: learning to recognise designers’ styles. Learn Instruct. 2009;19(2):185-199.
14. Baars M, van Gog T, de Bruin A, Paas F. Effects of problem solving after worked example study on primary school children’s monitoring accuracy. Appl Cogn Psychol. 2014;28(3):382-391.
15. Baars M, van Gog T, de Bruin A, Paas F. Effects of problem solving after worked example study on secondary school children’s monitoring accuracy. Educ Psychol. 2017;37(7):810-834.
16. Kant JM, Scheiter K, Oschutz K. How to sequence video modeling examples and inquiry tasks to foster scientific reasoning. Learn Instruct. 2017;52:46-58.
17. Leahy W, Hanham J, Sweller J. High element interactivity information during problem solving may lead to failure to obtain the testing effect. Educ Psychol Rev. 2015;27(2):291-304.
18. Leppink J, Paas F, van Gog T, van der Vleuten CPM, van Merriënboer JG. Effects of pairs of problems and examples on task performance and different types of cognitive load. Learn Instruct. 2014;30:32-42.
19. van Gog T, Kester L. A test of the testing effect: acquiring problem-solving skills from worked examples: cognitive science. Cogn Sci. 2012;36(8):1532-1541.
20. van Gog T, Kester L, Paas F. Effects of worked examples, example-problem, and problem-example pairs on novices’ learning. Contemp Educ Psychol. 2011;36(3):212-218.
21. Butler AC, Black-Maier AC, Raley ND, Marsh EJ. Retrieving and applying knowledge to different examples promotes transfer of learning. *J Exp Psychol Appl*. 2017;23(4):433-446.
22. Healy AF, Wohldmann EL, Sutton EM, Bourne LE. Specificity effects in training and transfer of speeded responses. *J Exp Psychol Learn Mem Cogn*. 2006;32(3):534-546.
23. Holladay CL, Quinones MA. Practice variability and transfer of training: the role of self-efficacy generality. *J Appl Psychol*. 2003;88(6):1094-103.
24. Paas FGWC, van Merrienboer JIG, van Merrienboer JIG. Variability of worked examples and transfer of geometrical problem-solving skills: a cognitive-load approach. *J Educ Psychol*. 1994;86(1):122-133.
25. Stokes PD, Lai B, Holtz D, Rigsbee E, Cherrick D. Effects of practice on variability, effects of variability on transfer. *J Exp Psychol Human Percept Perf*. 2008;34(3):640-659.
26. Andrus MR, McDonough SLK, Kelley KW, et al. Development and validation of a rubric to evaluate diabetes SOAP note writing in APPE. *Am J Pharm Educ*. 2018;82(9):6725.
27. Divine H, Jones M, Gokun Y, McIntosh T. Impact of curricular integration between patient care laboratory and introductory pharmacy practice experience on documentation. *Am J Pharm Educ*. 2020;84(2):7232.
28. Hausmann RGM, van de Sande B, VanLehn K. Are self-explaining and coached problem solving more effective when done by pairs of students than alone? Paper presented at: Proceedings of the 30th Annual Cognitive Science Society, 2008.
29. Reisslein M, Atkinson RK, Seeling P, Reisslein M. Investigating the presentation and format of instructional prompts in an electrical circuit analysis computer-based learning environment. *IEEE Transact Educ*. 2005;48(3):531-539.
30. Stark R, Gruber H, Renkl A, Mandl H. Does the combination of worked-out examples and problem-solving tasks pay off? *Zeitsch Padag Psychol*. 2000;14(4):206-218.
31. Yeo DJ, Fazio LK. The optimal learning strategy depends on learning goals and processes: retrieval practice versus worked examples. *J Educ Psychol*. 2019;111(1):73-90.
32. Koedinger KR, Booth JL, Klahr D. Instructional complexity and the science to constrain it. *Science*. 2013;342(6161):935-937.
33. Koedinger KR, Corbett AT, Perfetti C. The knowledge-learning-instruction framework: bridging the science-practice chasm to enhance robust student learning. *Cogn Sci*. 2012;36(5):757.
34. Catrambone R. Generalizing solution procedures learned from examples. *J Exp Psychol Learn Mem Cogn*. 1996;22(4):1020-1031.
35. Catrambone R, Hovyok KJ. Overcoming contextual limitations on problem-solving transfer. *J Exp Psychol Learn Mem Cogn*. 1989;15(6):1147-1156.
36. Gick ML, Hovyok KJ. Schema induction and analogical transfer. *Cogn Psychol*. 1983;15(1):1-38.
37. van Gog TV, Kester L, Dirkx K, Hoogerheide V, Boerboom J, Peter PJLV. Testing after worked example study does not enhance delayed problem-solving performance compared to restudy. *Educ Psychol Rev*. 2015;27(2):265-289.
38. Paas FGWC, Van Merrienboer JIG. Variability of worked examples and transfer of geometrical problem-solving skills: a cognitive-load approach. *J Educ Psychol*. 1994;86(1):122-133.
39. Quilici JL, Mayer RE. Role of examples in how students learn to categorize statistics word problems. *J Educ Psychol*. 1996;88(1):144-161.
40. Renkl A, Stark R, Gruber H, Mandl H. Learning from worked-out examples: the effects of example variability and elicited self-explanations. *Contemp Educ Psychol*. 1998;23(1):90-108.