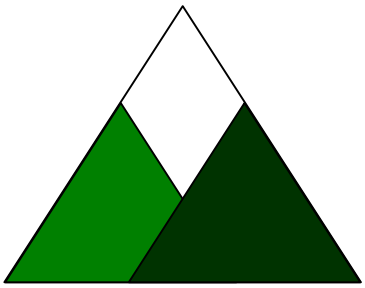

WORK-LEARNING RESEARCH

Simulation-Like Questions: The Basics of How and Why to Write Them

Will Thalheimer, Ph.D.

Simulation-like questions present learners with realistic decisions. Because of the authentic nature of their design, these questions produce more powerful learning benefits than most other forms of questioning. At the same time, they require significantly fewer resources than full-blown simulations. This document shows how to write these questions, describes the learning research that supports their use, and outlines ways to improve learning outcomes by 190% or more.

This document is made available for free by Work-Learning Research. To purchase or preview a more comprehensive report on simulation-like questions, visit the following website: www.work-learning.com/ma/pp_wp002.asp.

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Quick overview

Simulation-like questions present learners with realistic decisions. Because of the authentic nature of their design, simulation-like questions produce more powerful learning benefits than most other forms of questioning. At the same time, they require significantly fewer resources than full-blown simulations. This document shows how to write these questions, describes the learning research that supports their use, and outlines ways to utilize them that can improve learning outcomes by 190% or more.

Please answer the following question before continuing

Question 1.
You develop a set of brilliantly designed simulation-like questions and present them to your learners an hour after the accompanying instruction. You expect that 75% of the questions will be correctly answered. Which of your learners will be most likely to remember the material being referenced by your questions?

A. Those who read each question, answer the question, look at each answer, and then reflect briefly on the question and answer.
B. Those who read each question, peek ahead to the answer, and then spend time reflecting on the question and answer.
C. Both options will produce equally high levels of learning.

Don't look ahead to the answer! Stop now and answer the question! Circle your chosen answer if that helps you to make a commitment.

The correct choice is the Sixth Letter in the series: ACBCBAC

Note: A is the sixth letter and thus the correct answer. We disguise the answers in this document so you won't accidentally peek at them.

Questions have their most powerful effects by providing learners with practice in retrieving information from memory. If learners don't answer questions before looking at the answers, they won't receive this benefit.

This is offered as the first question in this document so that you'll answer the remaining questions without skipping ahead to the answers and feedback. The research is pretty clear that if you give learners a chance to peek at the answers, they will—at least some of the time—thus short-circuiting their learning. As the reader of this document, the responsibility is yours. You can be lazy and peek at the answers, or you can process each question fully to get the most out of it. You're likely to boost your learning by over 50% if you choose to answer each question before moving forward!

What is a simulation-like question?

Question 1 above is a well-written simulation-like question. It provides learners with a brief realistic scenario and asks them to respond. Simulation-like questions need not be multiple-choice questions. They also can be true-false questions, check-all-that-apply questions, fill-in-the-blank questions, or recall questions. As we will see later, each type of question has advantages and disadvantages, although some are generally more effective than others.

Several things set simulation-like questions apart from other types of questions.

1. Each question presents a brief realistic scenario.
2. Each question (including its alternative answer choices, correct answer, and feedback) highlights one or more key learning points.
3. Each question shows how the world works, or should work, by outlining a real-world cause-and-effect relationship.
4. Each question asks the learner to respond in a manner that shows he or she understands the key learning point.

Please answer the following question before continuing

Question 2.
You and your team decide to use simulation-like questions, but you can't decide what format to use. Which of the following formats will produce the best performance on the job if learners fully answer all of the questions?

A. True-false questions.
B. Multiple-choice questions.
C. Recall questions (for example, short-answer and fill-in-the-blank).
D. All of the above will produce similar results.

Don't look ahead to the answer! Stop now!

Correct choice: Sixth Letter: AECABDC

In general, recall questions produce better performance than multiple-choice questions, which are better than true-false questions.

One of the reasons that simulation-like questions are so effective is that they prompt learners to retrieve information from memory in the same way they'll have to retrieve it in their real-life performance environments. In most situations when we retrieve

information from memory, we aren't given multiple-choice alternatives. Because recall questions mirror the performance situation more fully than recognition questions (for example, multiple-choice and true-false questions), they are generally more effective in prompting successful on-the-job performance. Recall questions are also more powerful because they prompt deeper cognitive processing than recognition questions. In fact, researchers have found that even if you want learners to perform well on multiple-choice tests, the best way to have them prepare is by having them practice on recall tests—not multiple-choice tests.

If you can get people to answer recall questions as part of the learning, in most situations they will perform better on the job. Of course, learners often skip questions that are too difficult and forgo the advantage of trying to come up with an answer. Recall questions that are too difficult will produce no advantage over multiple-choice questions if learners don't process the recall questions fully.

The benefits of simulation-like questions

As we've seen, the use of questioning has advantages because it prompts learners to retrieve information from memory. In comparison to other forms of questions, simulation-like questions produce additional benefits because they mirror the kinds of problems and decisions that learners will have to deal with on the job. They enable learners to practice decision-making in the areas that are queried. To use the jargon of learning researchers, they prompt retrieval practice.

Please answer the following question before continuing

Question 3.
You and your team decide to use 80% multiple-choice questions and 20% short-answer questions. Several people on your design team suggest that questions may produce their benefits because the questioning prompts learners to spend more time on the material, not because of the questions per se. You can't resolve the argument, so you create two different versions of the instruction to see which one works better. Which version will produce greater long-term learning?

A. The instruction that includes 30 minutes of learning-material presentation, plus 30 minutes of questioning.
B. The instruction that includes 30 minutes of learning-material presentation, plus 30 minutes of review and study time.
C. Both versions will produce similar results.

Stop now! Do not peek at the answer!

Correct choice: Sixth Letter: CBABCAB

Providing questions creates more long-term retention of the learning points than utilizing the same time for study or review.

Research has found that providing learners with retrieval practice is much more powerful than giving them the same amount of time to restudy the learning material. Typical improvements range from 30% to 100%.

Please answer the following question before continuing

Question 4.
Your design team has finally agreed that questioning is a good practice. However, several members of your team are hesitant about using simulation-like questions that mirror the performance environment too closely. They argue that the learners will get too involved in whether the details of the questions are correct. The team outlines several options for how to write the questions, and they ask you to pick the best option. Which of the following types of questions will create the best on-the-job performance?

A. Questions that are simple and direct and don't add a lot of detail.
B. Questions that are fairly simple yet include realistic decisions like those that learners will face in their on-the-job performance situations.
C. Questions like those in Choice B above, which also include realistic background context that learners will encounter on the job.
D. Choices B and C will both produce equally superior results.

Stop now! Peeking will hurt your learning!

Correct choice: Fourth Letter: DBACDBA

Providing learners with realistic practice in the most realistic environment produces the best learning.

To understand why this happens, it helps to understand several subtleties about the human learning system. Learners don't just absorb the main learning points during learning. They also take in the background stimuli, and they store the learning points and the background information together in memory. It may be helpful to imagine the learning points as ink on a sheet of paper. The ink can't easily be separated from its background.

It's also helpful to realize that the human cognitive system is mostly reactive, not proactive. Environmental stimuli have a large influence on our thoughts. If I tell you to say the first thing that comes into your mind when I say "hot," you're likely to say "cold." When I say "shoe," you're likely to say "sock." To some extent, my words control your thoughts. When a tennis player sees a weak ball coming over the net, she immediately thinks about hitting a winner. When we see a friend cry, we react with empathy. In sum, the world around us influences what we think and what we do.

This point is particularly critical for this discussion as it relates to the learner's on-the-job performance context. Too often we as instructional designers focus on the learning situation and think about the performance situation only during our initial needs analyses or our after-instruction results assessments. Understanding how humans act in their performance situations is critical in creating effective learning interventions. Because humans are reactive, one of our most critical instructional goals should be to get learners to respond to stimuli in their on-the-job performance situations by remembering what they've learned and applying it appropriately. We want to create spontaneous remembering.

One reason that simulation-like questions are so effective is that they contain elements that will be stored in memory along with the learning points. Later, when learners encounter similar elements in the performance situation, they'll be reminded of the learning points. They'll remember more of what they learned! It's that simple. Researchers have even found that learners perform better on tests when they take the tests in the same rooms they learned in. The environmental stimuli in the room spontaneously remind learners of what they learned. Typically, researchers have found 10% to 55% better remembering in same-context situations than in different-context situations.

To reiterate this very important point, the more we can mirror the performance context during learning, the more our learners will be able to recall.

Please answer the following question before continuing

Question 5.
Your design team wonders about the importance of feedback. Which of the following designs will enable learners to remember more key learning points on the job a week or two after the instruction?

A. Provide no feedback for each question.
B. Provide brief feedback for each question.
C. Provide extensive feedback for each question.

Answer the question first! Stop peeking!

Correct choice: Seventh Letter: ABCBCAB

> Feedback can have powerful effects on learning because it helps learners to correct their misconceptions. Unless the material is very complicated, brief feedback is generally the most useful.

Feedback is essential when learners answer questions because it helps them correct their misconceptions. In general, feedback should only provide enough information to help learners understand the corrections that are needed. Additional feedback is counterproductive, unless the learning material is very complex. Offering praise when learners get answers correct, or providing empathetic handholding when learners get answers wrong, is generally not beneficial. Feedback typically improves learning outcomes by 15 to 50% or more.

Please answer the following question before continuing

> **Question 6.**
> **Your design team has a question about when to present feedback to learners. Suppose for this question that the learners are expected to get about 90 to 95% of the questions correct. Which design decision will produce the best learning?**
>
> A. Provide feedback on correct answers only.
> B. Provide feedback on incorrect answers only.
> C. Provide feedback on both correct and incorrect answers.
> D. Choices B and C will produce similarly superior results.
>
> Answer the question first! Stop peeking!
>
> Correct choice: Fourth Letter: ABCDCAB
>
> Feedback has its effects because it helps learners to correct their misconceptions. It has virtually no effect when learners know the answer and get it correct. In the type of case described by the question above—when learners get most of the answers correct—feedback on correct answers provides very little practical value, and it can even annoy the learners.

Feedback corrects misconceptions. If learners know an answer and get it correct, providing feedback produces no learning benefits whatsoever. Recall that the advantage of questioning lies in its ability to provide retrieval practice for learners. If they've already received appropriate retrieval practice—as they will when they get an answer correct—they've already strengthened the correct memory. Feedback adds little to this

effect. In fact, research has shown that feedback on correct answers can annoy learners enough that they tune it out altogether.

Does this mean that feedback should never be given on correct answers? No, the story is a bit more complicated than this. Learners will sometimes get answers correct even when they don't know anything about a topic. They will guess when they don't know an answer. In these cases, we need to provide learners with feedback. The trouble is that we don't really know when they're guessing and when they're not. All we know is that they got an answer correct. Sometimes, then, it's beneficial to provide learners with feedback on correct answers.

In the question above, learners are getting most of the answers correct. If they average 92% correct, then they're likely to be guessing at only about 2% of the questions[1]. Is it worth providing feedback on 92% of the questions to improve learning on about 2% of those questions? Although the answer depends on the topic and other circumstances of the learning, if we assume this feedback will annoy many learners to the point of distraction, it appears that in this case the costs of the feedback are more likely to outweigh the benefits.

On the other hand, if the material is very difficult and learners are getting lots of answers wrong, it may be beneficial to provide them with feedback on their correct answers. Suppose learners are getting 60% correct. That means they are probably guessing at half the answers and are guessing correctly on 10% of the questions[2]. In this case, it might be beneficial to provide feedback on the 60% correct answers to repair the misconceptions involved on almost 17% of those questions. Again, the constraints of the topic, situation, and instruction must inform this decision-making.

There is another instructional-design possibility. We can provide learners with feedback on their incorrect answers while we provide them with the option of getting feedback on their correct answers. This can be accomplished through a very simple mechanism. When learners get an answer correct, they receive the feedback, "Correct" plus an option that says, "More Feedback Details?" It can be as simple as that.

[1] If learners receive 100 five-item multiple-choice questions, random guessing will produce 20% correct responses. We know that someone getting 92% correct has gotten 8 wrong. We can assume they guessed on these 8 questions plus several other questions that they happened to get correct. How many did they guess and get correct? Well, if 8 represents 80% of all the answers they got wrong from guessing, then we can calculate that 2 is the number of questions that they guessed on.

[2] If learners receive 100 five-item multiple-choice questions, random guessing will produce 20% correct responses. We know that someone getting 60% correct has gotten 40 wrong. We can assume they guessed on these 40 questions plus several other questions that they happened to get correct. How many did they guess on and get correct? Well, if 40 represents 80% of all the answers they got wrong from guessing, then we can calculate that 10 is the number of questions that they guessed on.

Key learning points so far

We've learned that (1) learners will learn more from questions they actually answer—instead of peeking ahead, (2) questions produce powerful effects because they give people practice retrieving information from memory, and (3) the more our questions mirror the targeted real-life performance context, the better the remembering and the better the performance. We've also learned what makes a simulation-like question unique—it presents a realistic scenario, highlights a real-world cause-and-effect relationship, and asks learners to make a decision to display their understanding of this relationship. Finally, we learned that feedback can be very useful in correcting learner misconceptions.

Improving your question writing

The task of writing simulation-like questions requires the same skills as writing any instructional script, plus a few more.

Although most of us have learned that it is best to start with very clear instructional objectives and to create instruction with those objectives in mind, my experience as a writer of simulation-like questions is that sometimes it's okay to start with the creation of questions. This practice enables us to be creative and to generate innovative question topics. It also pushes us beyond the boundaries of our initial designs, allowing us to build more complete instructional sequences. Whether you go from objectives to questions, or you write your questions with only a skeletal understanding of your goals for each question, it's important that by the completion of your first draft each question has a clear and vital reason for its existence. In other words, when all is said and done, each of your questions should have an instructional objective[3]. You'll have to figure out the best way to make the journey from beginning to completion.

With the need for flexibility in mind, the following sequence may work for you:

1. Before you begin, you should have already determined that simulation-like questions are an appropriate learning intervention for your learners. You should understand how they will be used in your instruction, how they will benefit your learners, and how they will improve the performance of your learners when they return to their jobs.

[3] To learn more about the research on instructional objectives and practical recommendations for their use, see Dr. Will Thalheimer's report entitled *Instructional Objectives: A Work-Learning Research Instructional Research Report*, available from the Publications page at www.work-learning.com.

2. Think about your overarching objectives. Why are you writing these questions? What do you want your learners to know? What situations will your learners face on the job? By answering these and other general questions for yourself, you'll create some initial guidance for your writing. Make sure you write down your answers and keep track of your notes so that you'll remember them.

3. Learn the topic material. This is vital so that you can create rich, meaningful questions and so that you can determine how the material applies to the learners' on-the-job performance situations.

4. Learn about the learners' performance situations. If you're going to create meaningful scenarios that mirror different performance situations, you have to know what these performance situations are like. Although you ought to have a general sense of the learners' day-to-day activities, it is most important to focus on the specific situations relevant to the topic.

5. Create a list of all of the specific learning points you want learners to know. Because these are simulation-like questions you're developing, try and keep most of your learning points focused on cause-and-effect relationships. In addition, keep in mind the following question as you develop your list of specific learning points: "What do you want your learners to do, and in what situations do you want your learners to do those things?" By keeping in mind the cause-and-effect relationship and the situated actions you want your learners to be able to perform, you'll be able to create the most powerful types of questions.

6. Begin writing a simulation-like question for each learning point.

7. Write other questions that seem relevant, that focus on performance situations not covered, or that intrigue you. Do a reality check. Ask yourself whether the question really teaches a key learning point.

8. After your questions are written, reread each one and remove any extra words, sentences, or decision choices that don't add something valuable.

9. Create brief feedback for each question or each decision choice. Feedback is most beneficial if it is very concise and direct. Praise for correct answers and empathetic responses for incorrect answers are not useful.

10. If you plan to provide additional practice—generally a good idea—write a second or third question for each learning point. Where applicable, vary the decision choices. Where appropriate, vary the background situation described in the scenario. Consider varying the question type and providing learners with more difficult types of questions, even the more realistic recall questions.

11. After you've completed your first draft, put it aside for a few days. Reread it again and make changes.

12. Get input from colleagues, clients, or other stakeholders. Tell them it's a rough draft and you'd like their input on the content. You may have to have a series of one-on-one conversations to explain the rationale for your instructional design and for the simulation-like questions in particular. This document should give you some ammunition.

13. Make changes based on their comments. As much as possible, avoid compromising good design principles for stakeholders' idiosyncratic whims. Do whatever politicking is required—this is an important part of being an instructional designer.

14. Hire a copy editor to review your draft. Make many of the changes he or she suggests.

The sequence above is a rough guideline. You'll need to determine what works best for you and your organization. In addition to this sequencing, several other guidelines are critical for writing simulation-like questions.

The scenario should be as short and concise as possible. In my first draft of Question 4 (which you already answered above), I had extra information that didn't add enough benefit to make it worth keeping. Below you'll see my first draft, with the sentences that were removed highlighted in italics.

> **Your design team has finally agreed that questioning is a good practice. However, several members of your team are hesitant about using simulation-like questions that mirror the performance environment too closely. They argue that the learners will get too involved in whether the details of the questions are correct.** *Although your team's skepticism is somewhat frustrating, you remind yourself that the acceptance of important workplace changes usually requires significant amounts of time and reflection.* **The team outlines several options for how to write the questions, and they ask you to pick the best option.** *You hire a well-respected learning-research firm to help you pinpoint the best practice. Your team is waiting.* **Which of the following types of questions will create the best on-the-job performance?**

Although I had good reasons for those extra sentences, their benefits were outweighed by the cost of having the extra text. The editing decreased the length of the scenario from 124 to 82 words, a sizable reduction of 34%. Longer scenarios may sometimes be needed, but learners will struggle to hold large amounts of information in working memory, and their learning may suffer as a result.

It's also important to weigh the importance of providing context. If your scenario is too short, it may not provide enough background context to promote context-based remembering during the performance situation. In the question immediately above, the phrases "design team," "simulation-like questions," and "mirror the performance context too closely" provide valuable context that you—the learner in this case—may utilize to remind yourself how to write simulation-like questions when you're faced with that task. But notice that the decision choices of multiple-choice questions can provide powerful background context as well. The Question-4 choices are repeated below:

A. Questions that are simple and direct and don't add a lot of detail.
B. Questions that are simple yet include realistic decisions like those that learners will face in their on-the-job performance situations.
C. Questions like those in Choice B above, which also include realistic background context that learners will encounter on the job.
D. Choices B and C will both produce equally superior results.

Because these present very real alternatives of the type you may grapple with when you write your own simulation-like questions, they are likely to pop into your head as you begin the writing task and thus remind you of the most appropriate ways to proceed.

Writing decision choices can be tricky as well. If possible, they should be short and sweet, but they should be long enough to clearly convey the intended meaning. There's nothing learners hate more than confusing answer choices. Avoid words like "never" and "always" or phrases that are unlikely ever to be true. It's best to go from simple to complex, keep numeric choices in order (one, two, three; not one, three, two), and to use the same words for each choice if you mean the same thing. Note how I used the word "simple" in both Choice A and B, instead of switching to "easy" in Choice B, just to add variety. Make sure that all the choices are plausible, and try as much as possible to avoid having one choice that is significantly better than the others. We want our learners to think deeply about the questions and grapple with realistic options. It's okay to do what I did in Choice C above—adding to a previous item—but keep this kind of intricacy to a minimum. It's also acceptable to offer two or more choices in one answer choice, as I did in Choice D above. This is especially valuable if it forces learners to tease apart the cause-and-effect contingencies taught in the question. For example, Choice D forces learners to decide whether it's the information about the decision or the background that makes a difference, or whether both contribute.

It's often tempting to place too much responsibility on one question. In general, it's best to cover one learning point per question. For example, instead of offering one multiple-choice question that covers two related learning points, it's better to offer two simple questions. This is one of the reasons that recall questions can be problematic, especially for complex topics. While they are more realistic than multiple-choice questions, they often don't enable a clear focus. A lack of focus can be detrimental because it may

prompt learners to pay attention to less important aspects of the learning material and it may create cognitive overload as learners search aimlessly for direction.

The exception to the one-learning-point-per-question rule is when one complicated scenario is described and several alternatives (for example, check-all-that-apply alternatives) are offered that tease apart many separate learning points. This enables learners to process one complex scenario instead of many, creating some initial cognitive costs as learners struggle to make sense of the scenario's complexities but making up for those by prompting several decision points based on the same scenario. This type of question provides some of the realism of the real world—and thus has some of the advantages of a case study—while maintaining instructional focus.

To end this section on how to improve your question writing, it's important to remember that the purpose of simulation-like questions is to provide learners with practice on the types of decision-making they'll face in their real-world situations. The questions you write should be easily understood so that learners can experience that practice in relatively realistic scenarios. The suggestions about the sequence of writing provide you with proven methods that will help you to do the necessary preparation, to keep focused on the most important objectives, to reiteratively improve your writing product, and to navigate the perils of instructional politics.

Because the practice of providing questions is already a vast improvement over the use of less interactive materials, and because simulation-like questions are significant improvements over less-effective questions or interactions, the fact that you're writing these advanced questions will already put your instructional efforts high above the norm in terms of learning improvements. We've already seen that retrieval practice improves learning from 30 to 100%, and mirroring the performance context in your questions can improve learning from 10 to 55%. If you also provide feedback (15 to 50%), repetitions (30 to 110%), and other instructional supports, you're well on your way to improving learning outcomes by hugely significant amounts.

Improving the effectiveness of your questions even more.

This report provides the basics. After reading it, you should know how to write and implement simulation-like questions to produce significant learning gains.

Of course, there is always more to learn. A more comprehensive report includes exactly what this document contains, plus the following:

1. Eight additional simulation-like questions with augmenting discussions that describe why mouse-over feedback is not recommended, why delayed feedback is generally better than immediate feedback, the benefits of providing an additional question after learners get an answer wrong, the significant advantages of repetition, the benefits to varying and spacing repetitions over time, and the possibility of using simulation-like questions like you would use learning objectives.

2. A list of the 17 key learning points covered in the document. This list compiles all the major points and makes them easily available for review or dissemination to others.

3. A section that describes how simulations produce their benefits and highlights how simulation-like questions can produce the same benefits, creating learning improvements ranging from 50 to 190% or more.

4. A list of nine arguments you can use within your organization to advocate for simulation-like questions.

5. A two-page checklist of the question-writing process described herein.

Simulation-like questions are a powerful methodology backed by proven research-based instructional-design knowledge. Not only do they provide significantly improved learning outcomes, but they also do it very cheaply. To preview or purchase the comprehensive report on simulation-like questions, or just to learn more, visit the following Work-Learning Research web pages:

Simulation-like questions full report:	www.work-learning.com/ma/pp_wp002.asp
Work-Learning Research website:	www.work-learning.com
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