Learning
by SCIENTIFIC
DESIGN

*Early insights from a network
transforming teacher preparation*

**DEANS
FOR
IMPACT**

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DEANS FOR IMPACT

Learning *by*
SCIENTIFIC DESIGN

Early insights from a network transforming teacher preparation

Imagine you're a new sixth-grade teacher, midway through your first semester of teaching. Imagine further you are planning a lesson for the week, one related to an English Language Arts content standard focused on author's purpose. More specifically, you want your students to explore how authors use different types of texts for different purposes.

To explore this idea, you'll need a task. Since your existing curriculum doesn't tackle this standard directly, you go online, enter the relevant content standard into the searchbox of a popular lesson-sharing website, and examine your options. You home in on two alternatives popular with your fellow teachers:

ACTIVITY 1

Have students read a short news article and two short opinion pieces from the same issue of the newspaper.

Have students discuss the following questions in groups and post their responses on chart paper:
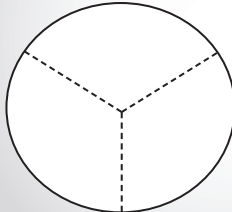
◆ *The two opinion pieces are very different but they also have some things in common. How do we know both authors are trying to persuade their readers of something?*

◆ *Make a list of differences between the news article and the opinion pieces. Which of these can be attributed to the authors' differing purposes?*

◆ *What would the author of the news article need to change if their purpose was to entertain instead of inform their reader?*

ACTIVITY 2

Ask students to go on a newspaper scavenger hunt. Provide them a newspaper and tell them to search for examples of each author's purpose described in the graphic organizer below. Have them record the titles of the articles they find in the graphic organizer.

Name _____

What piece of the P.I.E. is
the author giving you?

Persuade

Inform

Entertain

If you want students to understand the ways an author's purpose influences their writing, which activity do you choose – and why?

22%

**of future teachers
answered correctly**

While some might argue the answer is "it depends," we take a different view at Deans for Impact. This choice (or instructional decision) is one that teachers have to make all the time. And we believe there is a right and wrong answer– and that, if novice teachers possess a firm grasp of basic principles of learning science, they will be more likely to make the right decision.

As this scenario is constructed, the right answer is the first activity. That's because it requires students to make their thinking visible as they identify the features of texts that convey authorial purpose. In so doing, students begin to build a mental model (or "schema") for the key features of particular types of texts that are intended to inform, persuade, or entertain.

In contrast, the second activity simply requires students to sort texts into categories, and does not require them to do any deeper thinking about particular features of texts that relate to authorial purpose. Students who do not already understand the core concept being taught will be unlikely to properly sort articles by their headlines – and there's a risk they will just randomly sort headlines into the graphic organizer.

In short, while the PIE chart may appear more fun and engaging, it's less likely to lead to meaningful learning.

If you answered incorrectly – well, you're not alone. In Fall 2019, Deans for Impact asked more than 1,000 future teachers to answer this same question. Only 22% correctly identified the first task as superior to the second for understanding the different purposes for which authors write. What's more, those who chose the second activity (or were indifferent between them) explained their reasoning in ways that are illuminating:

> * *The second activity is easier.*
>
> * *The second activity is more inclusive to visual learners as the first activity is advantageous to audible learners.*
>
> * *The first activity is very boring, I didn't even want to read the questions. The second activity is more inviting, seems more hands on and is more inquiry learning.*
>
> * *Students are more likely to write meaningful responses in chart form versus paragraphs. Most students dislike writing prompts. Charting makes it more manageable.*
>
> * *Some students are kinesthetic learners and learn best when they are able to physically manipulate an object (such as cutting newspaper and gluing it) while other students do better with simply reading a prompt and then writing. Both learning styles are different and it is important to cater to all of your students' learning needs.*

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Here we see future teachers expressing views that do not align with the science of learning. Despite popular belief to the contrary, there is virtually no evidence supporting the notion that students learn more when information is tailored to their preferred "style," such as visual, audio, or kinesthetic. This claim is not controversial among scientists who study our minds, but this understanding is not widely shared. Further, choosing a task because it's easier compared to a more rigorous alternative is precisely what we don't want teachers to do.

Yet this data highlights what we believe is an eminently solvable problem. After all, we should not expect future teachers to start their preservice preparation with a firm grasp of principles of learning science. Instead, this specialized knowledge of learning science…needs to be learned! That learning should start at educator-preparation programs, so that – by the time they complete their preservice preparation – future teachers both understand the basics of learning science, and are able to apply that knowledge in their teaching.

The report that follows explains how we are working with six educator-preparation programs to make that happen.

WHAT WE MEAN BY *LEARNING SCIENCE* AND *LEARNING BY SCIENTIFIC DESIGN*

Deans for Impact believes all teachers should understand basic principles of learning science – but what does that mean?

We view the science of learning primarily through a cognitive lens. Cognition describes the process of how humans think and learn. The last several decades have deepened our scientific understanding of how our minds process and store new information, and how we apply that knowledge to novel situations.[1]

Early in Deans for Impact's organizational existence, we issued a publication – *The Science of Learning* – that lays out a few of the basic principles of cognition that we think teachers should know. At a mere six pages, *The Science of Learning* is not meant to be all-encompassing, but we think it can serve as a foundational text for educators who want to incorporate our best available understanding of how we learn into their "mental model" of teaching.[2]

What do we mean by mental model? All teachers, whether implicitly or explicitly, employ a theory of learning when they teach. By this we simply mean that teachers have a set of beliefs and expectations about how their instructional decisions will foster learning with their students. Those beliefs and expectations comprise a teacher's mental model – and we believe that model should be informed by our best available scientific understanding of how we learn.

For example, consider one bedrock principle of learning science: Students learn new ideas by referencing ideas they already know. There's a great deal of complexity contained within that seemingly straightforward notion, and we think it's vital for future teachers – and practicing ones, for that matter – to grapple with its implications. Among other things, this principle underscores the need to teach students a broad array of content across subjects; to carefully sequence how such information is presented to students; and to understand that knowledge is cumulative, such that it becomes easier (or harder) for students to learn new information based on their existing knowledge. All of these ideas bear upon how teachers should instruct their students.

And the ways in which that happens pedagogically is a matter of design. Teachers are designers. They design experiences for students that, when successful, lead to student learning. And it is our hypothesis at Deans for Impact that teachers will design more successful learning experiences if they incorporate principles of learning science into their instructional design choices.

All of this is why we call our work in this area "Learning by Scientific Design." In what follows, we go into more detail about this effort, and how we've brought together a network of educator-preparation programs who embrace the role of learning science in informing teaching practice.

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[1] We distinguish cognitive science from neuroscience. The latter, while interesting, describes neurobiological processes within the brain that do not strike us as particularly useful for teachers to know, at least for now. There is a difference between a mental (or cognitive) process that is made evident through behavior – which teachers do need to understand – and the underlying chemical or biological reaction happening underneath (which they don't). An analogy may help explain this difference: You don't need to know how the internal combustion engine works in order to drive a car.

[2] *The Science of Learning* is available for free download at https://deansforimpact.org/resources/the-science-of-learning/

LEARNING BY SCIENTIFIC DESIGN NETWORK

Network Participants

In Fall 2019, Deans for Impact formally launched the Learning by Scientific Design Network. Through the LbSD Network, we are presently supporting six programs that want to deeply integrate learning science throughout the preparation experiences they provide to their teacher-candidates. The participating institutions include:

- American University
- Endicott College
- Louisiana Resource Center for Educators
- Temple University
- University of Missouri-St. Louis
- University of North Carolina-Charlotte

Over the next two years, this first cohort of participating programs will transform how they prepare future teachers through the lens of learning science. Activities include:

- **Identifying program teams.** Each program has identified four to six faculty and staff members to serve as the LbSD Network team that will drive this work. These teams typically include directors of teacher-education and key faculty responsible for introducing learning-science principles to teacher-candidates.

- **Convenings.** The LbSD Network teams will meet at multiple times throughout the two-year improvement cycle, to plan for specific changes to coursework and clinical experiences that better support candidates in their understanding of learning science.

- **Site visits.** Deans for Impact staff is conducting visits to participating programs to provide customized support for this work. We will deliver learning modules intended to build understanding by examining specific instructional artifacts (for example, by analyzing the rigor and relevance of a third-grade math lesson through the lens of cognitive science). We will also facilitate observations of candidate practice and coursework to deepen participants' understanding of what these principles look like in practice.

- **Virtual coaching.** Deans for Impact provides monthly virtual coaching sessions with each team. These sessions are designed to support programs as they undertake the hard work of redesigning courses and fieldwork experiences.

Learning by Scientific Design Focus Principles

One of our first steps in the LbSD Network was to identify specific principles of learning science the network would focus on. Because Deans for Impact believes that change efforts that take on too much often result in very little, we wanted to agree on a core set of "focus principles" to drive our work with participating programs. There are six such principles:

FOCUS PRINCIPLES

Connecting the Dots
Students learn new ideas by reference to ideas they already know.

Practicing with Purpose
Practice is essential to learning new facts, but not all practice is equivalent.

Managing the Learning Load
Learning can be impeded if students are confronted with too much information at once.

Building Feedback Loops
Effective feedback is essential to acquiring new knowledge and skills.

Deepening Meaning and Learning
We usually want students to remember what information means and why it is important, so they should think about meaning when they encounter to-be-remembered material.

Creating a Motivating Environment
Students will be motivated to learn in environments where they feel safe and valued.

Learning by Scientific Design Assessment

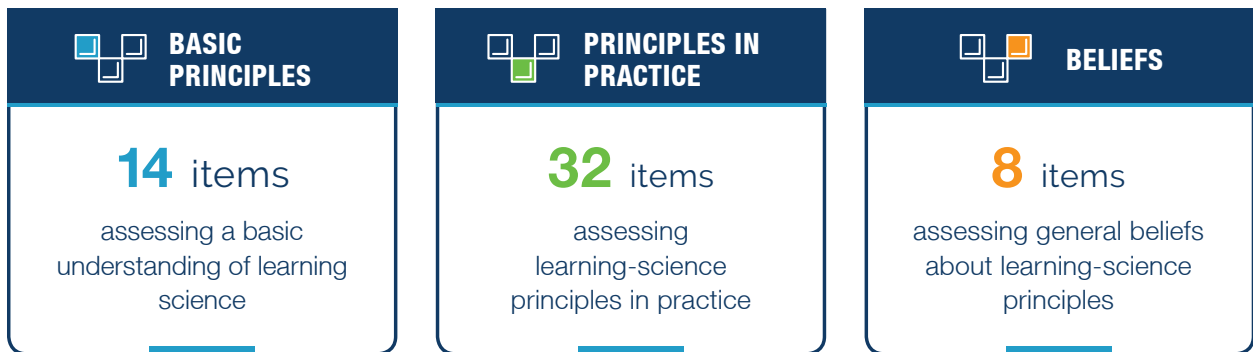With our focus principles identified, the next stage posed an even greater challenge. We believe evidence is critical to driving improvement efforts – but how might we gather evidence of what teacher-candidates (and teacher-educators) already know about these focus principles? We initially hoped we could identify a preexisting tool to use, but our search failed to turn up anything we felt confident in.

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So, with the help of our advisory board (see appendix), we built a prototype of an assessment expressly designed to surface understanding of our key focus principles of learning science, so that we could use the data formatively with the programs we work with. Our goal was (and is) to provide an evidentiary foundation for programs to design targeted changes to coursework and field placements.

Designing assessment items for this purpose wasn't easy. Each one we created went through several rounds of expert review and revision. This review began with cognitive scientists on our advisory board vetting items for content accuracy. Next, we engaged in a series of interviews with educators, as well as people with no background in education, to determine what knowledge people pulled from as they answered each question, paying special attention to whether people relied on knowledge that differed from the knowledge we wanted to assess. Finally, we piloted the items with groups of teachers, teacher-educators, and teacher-candidates, and used their feedback to make final revisions.

After all that, we developed a 54-item assessment that's comprised of three domains:

LbSD ASSESSMENT

BASIC PRINCIPLES	PRINCIPLES IN PRACTICE	BELIEFS
14 items	**32** items	**8** items
assessing a basic understanding of learning science	assessing learning-science principles in practice	assessing general beliefs about learning-science principles

The LbSD assessment has been developed for purposes of supporting our improvement work with programs that want to integrate learning science into how they prepare future teachers. While we are in the process of evaluating the psychometric properties of the assessment (that is, whether the items are valid and reliable measures of whether teacher-candidates understand learning science), our main aim was and is to generate formative data that will help teacher-educators think about how to improve teacher-candidate understanding of learning science.

To that end, the six LbSD Network participants administered the assessment in Fall 2019, with approximately 1,036 teacher-candidates completing it. In keeping with our formative goals, programs will administer the assessment again in Spring 2020 and Spring 2021 to evaluate the progress that their teacher-candidates have made in understanding key focus principles of learning science. And our hope is that programs will continue to use this data beyond the current two-year timeframe of the LbSD Network to continually improve.

Now for some caveats: Not every teacher-candidate within an institution took the assessment, nor did we control for how far along candidates were within their programs. And of course the programs participating in the LbSD Network were not randomly selected, but rather chosen because of their interest in using learning science.

For that same reason, however, our hunch is that the data generated from this assessment is more likely to overstate what most teacher-candidates know about learning science, relative to the broader field of educator preparation. Because Deans for Impact has long championed the potential value of using learning science in teaching practice, we suspect we've attracted leaders from programs that share our hypothesis. Of course, it's possible that there are programs out there that place as much or more weight on principles of learning science, but we aren't aware of any (and if you know of such programs, please get in touch!).

In addition to teacher-candidates, 22 teacher-educators participating in the LbSD network also took the assessment. We don't claim that this sample generalizes to the broader population of teacher-educators in the US. Nonetheless, we found the performance of teacher-educators on this assessment interesting, insofar as they suggest participating teacher-educators possess a relatively robust understanding of how to apply learning-science principles in practice, without necessarily knowing the scientific details of the principles themselves.

The next section explores these early insights in more detail.

EARLY INSIGHTS

There are the six major takeaways from our first administration of our Learning by Scientific Design assessment.

1. In general, future teachers are unfamiliar with basic principles of learning science – and they struggle to connect these principles to practice.

As noted previously, a bedrock principle of learning science is that we learn new ideas in reference to ideas we already know. If we want future teachers to understand and apply learning science, the starting point for building their knowledge is determining what they already know about basic ideas of cognition. Likewise, if we want future teachers to use learning science to inform their instruction, we need to have some idea of whether and how they connect this science to their practice.

Now for some sobering news: Based on the results of our assessment, teacher-candidates possess a shallow understanding of basic principles of learning science – and, perhaps as a result, they struggle to make instructional decisions that are consistent with our best scientific understanding of how students learn. Here are the overall scores:

Teacher-Candidate Network Domain Averages
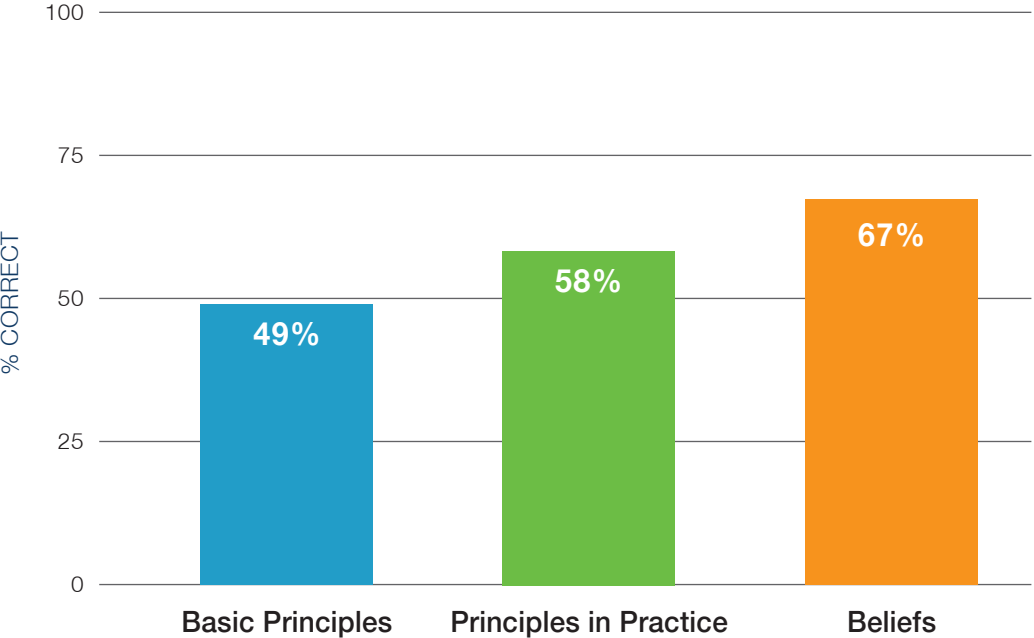
NOTE

These results show the unweighted average scores of 1,036 teacher-candidates on each domain of the LbSD assessment

What specific principles of learning science do teacher-candidates struggle with? Here's one example from a simple true-false question:

6%

of future teachers answered correctly

"Any kind of repeated exposure to information makes it more likely the information will be moved into long-term memory."

Only 6% of teacher-candidates correctly identified this as false. Exposure to information is not, by itself, enough to ensure information is encoded into our long-term memory. Put simply, information can only be remembered if the learner actively thinks about it. This is why lecturing can be effective if the teacher successfully stimulates student thinking, *or* can be remarkably ineffective if students are bored.

Another example:

18%

of future teachers answered correctly

"Information you want to remember is more likely to make it into your long-term memory."

Only 18% of teacher-candidates correctly identified this as false. This is one of the harder questions on our assessment, and one that cuts against many educators' intuitions. But experiments show that simply wanting to learn something does not increase the likelihood it will be remembered. Again, what matters is whether and how the information is processed – and although it may seem counterintuitive, it's possible to think about and remember information you have no real desire to learn, just as it's possible to forget that which you are highly motivated to learn.

What about connecting learning science principles to practice? Via the "PIE example" at the beginning of this report, we've already shared one example of how teacher-candidates can gravitate to specific instructional activities that are unlikely to support learning (at least in the absence of additional guidance). We think this challenge is particularly acute for novice teachers, given that they will lack the experiential knowledge to help them modify tasks and lessons in ways that may foster productive student learning.

Here's good news: We only have this data because the six educator-preparation programs participating in the LbSD Network voluntarily agreed to administer this assessment and share the results publicly. What's more, these same programs are already undertaking the hard work of redesigning coursework and clinical experiences to strengthen how teacher-candidates connect these principles to practice. At Deans for Impact, we're often told "schools of education will never change" but these programs (and others) are changing right now, with our support.

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2. Encouragingly, future teachers recognize the critical role that background knowledge plays in learning.

Although teacher-candidates' overall performance on our learning-science assessment is not yet where we want it to be, there were some relative bright spots. In particular, future teachers seem to appreciate the critical role of background knowledge – i.e., knowledge that is stored in a learner's long-term memory – to learning. As evidence of this, here is the prompt for three questions related to an excerpt from a speech by Frederick Douglass:

As prework for a seminar in their U.S. History course, a teacher asked their students to read Frederick Douglass's speech, *"What, To The Slave, Is The Fourth of July?"*

An excerpt of this speech is printed below.

> *I shall see, this day, and its popular characteristics, from the slave's point of view. Standing, there, identified with the American bondman, making his wrongs mine, I do not hesitate to declare, with all my soul, that the character and conduct of this nation never looked blacker to me than on this 4th of July!*

The teacher expects that after reading this speech students will understand that Frederick Douglass is calling out the hypocrisy of White Americans who want to celebrate the United States as a country that protects liberty and equality – while the nation's laws preserve slavery.

Each of the sentences below describes things that might influence whether students will store the meaning of the text in long-term memory. For each mark "True," "False," or "I don't know."

1 *Learners who are familiar with many of the vocabulary words and phrases in the text will be more likely to store the meaning of the text in long-term memory.*

79%

2 *Prior knowledge allows students to substitute in information not explicitly stated in the text (e.g., "Fourth of July" = holiday often described as a celebration of freedom) making it more likely they will store the meaning of the text in long-term memory.*

86%

3 *Students' reading comprehension skills are more important than their knowledge of relevant U.S. history to ensure they remember the information.*

34%

of future teachers answered correctly

Here's more good news: 79% of teacher-candidates correctly identified that learners who are familiar with vocabulary and phrases used in Douglass's speech will be more likely to remember its meaning (rather than struggle to decode the text itself). Relatedly, 86% of teacher-candidates correctly stated that students' prior knowledge can help them to interpret the passage by adding additional information not contained directly in the text, which in turn enhances the likelihood of them focusing on the meaning.
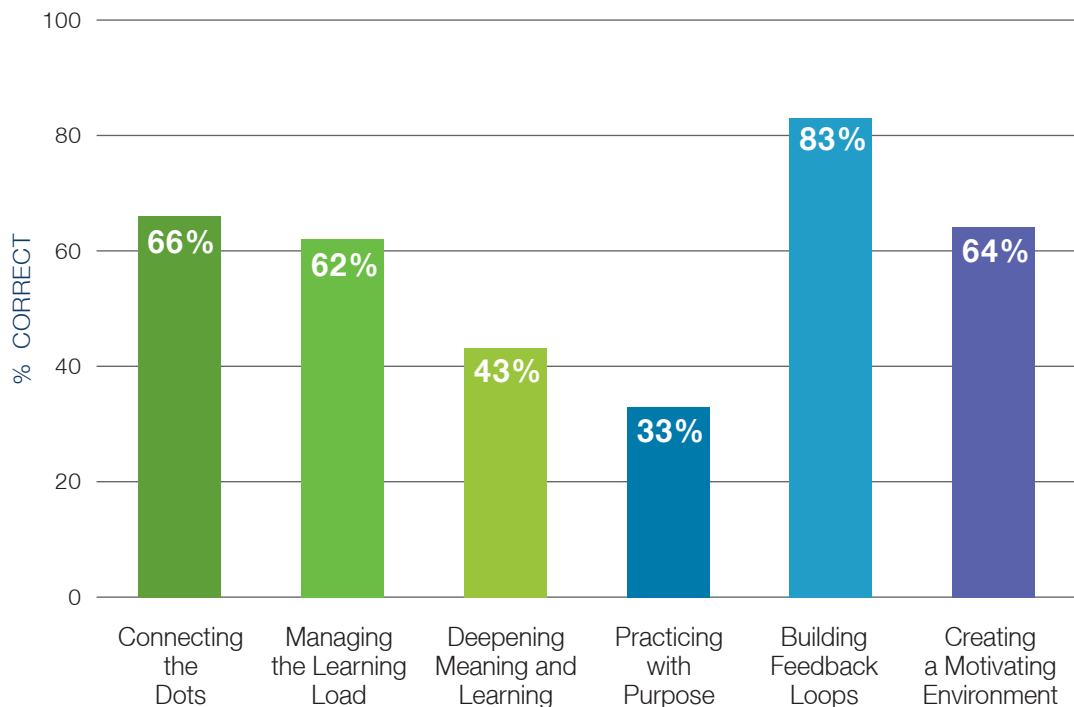
That said, there's room for improvement here too. Only 34% of respondents correctly identified that the third statement is false. There's little empirical support for the idea of building generic "reading comprehension skills" in students. In fact, we largely comprehend based on what knowledge we already possess. The implication is that teachers who want students to grapple with the ideas contained in Douglass's speech on the 4th of July should think about how to foster the necessary knowledge in their students, such as by introducing contextual information on slavery and the history of the holiday itself, rather than trying to develop generic "comprehension skills."

3. Future teachers struggle to identify effective forms of practice – and they appear to conflate student engagement with learning.

The majority of items on our learning-science assessment are tied to the six key "focus principles" of the Learning by Scientific Design Network. Here's how teacher-candidates scored:

Network Averages on Learning Science Principles in Practice

Bar chart — % CORRECT:
- Connecting the Dots: 66%
- Managing the Learning Load: 62%
- Deepening Meaning and Learning: 43%
- Practicing with Purpose: 33%
- Building Feedback Loops: 83%
- Creating a Motivating Environment: 64%

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This data highlights two areas as opportunities for improvement: Practicing with Purpose, and Deepening Meaning and Learning.[3]

From the perspective of learning science, practice is essential to learning new information – but not all practice is equivalent. At Deans for Impact, we explored this idea in detail in *Practice with Purpose*, our report on how to structure practice to lead to durable learning. Among other things, effective practice should provide students with repeated opportunities to improve over time (what some cognitive scientists refer to as "spaced practice").[4]

Here is one item from our assessment that explores this idea:

After teaching students the names of the branches of the US government and what each does, which would be the most effective way a teacher could help their students remember this information?

A   *Have students read the facts for 10 days at the beginning of class*

B   *Have students copy the facts into a notebook where they can reference them as needed*

C   *Have students take a once-a-week quiz for 10 weeks where they recall the facts from memory*

D   *Have students participate in a review game where they have to recall the facts from memory several times in one class period*

13%

of future teachers answered correctly

The correct answer is (c) – but only 13% of teacher-candidates picked this option. In contrast, 60% of teacher-candidates picked (d), the in-class review game. Yet if choosing among these options, we should want novice teachers to use no-stakes quizzing as one method to ensure students regularly have to retrieve information from their memories, which makes learning more durable. An in-class game might be used as one such method of retrieval, but it's an inferior strategy to frequent quizzes.

Similarly, teacher-candidates struggled with questions related to "deepening meaning and learning." Again, our "PIE" example at the outset of this report illustrates the complexity of this challenge. When asked to choose between two tasks related to a specific content standard about authorial intent, the majority of teacher-candidates

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[3] Though these results suggest teacher-candidates understand how to provide effective feedback, our assessment contained only two items related to this principle so we do not draw any conclusions from that limited data set. Future iterations of the assessment will include more feedback-related questions so we'll have better information.

[4] *Practice with Purpose* is available for download at **https://deansforimpact.org/resources/practice-with-purpose/**

chose the task involving a graphic organizer that they thought appeared more "fun" and appropriate for their "visual learners." Far fewer chose the more rigorous task that prompted students to identify the key features of different sorts of texts.

This is why we believe deeply in the potential power of learning science to help novice teachers. Teachers need to distinguish between engaging students in service of learning versus engagement for the sake of engagement. This is a subtle but vital point. Engagement is not enough – students need to think *about specific content* in order to learn.[5]

4. For the most part, teacher-candidates hold beliefs about teaching and learning that align to principles of learning science – but there are clear areas for improvement.

In addition to assessing whether teacher-candidates know principles of learning science, and how to apply them in practice, we were curious whether teacher-candidates hold beliefs that align with our best scientific understanding of how we learn. To determine this, we asked teacher-candidates to indicate – on a 10-point scale, with 1 = low and 10 = high – the degree to which they agreed or disagreed with eight statements related to specific principles of learning science. These items were not nuanced – each one was designed to prompt teacher-candidates to strongly agree or disagree.

Here's how teacher-candidates scored:

Network Averages on Beliefs About Learning Science
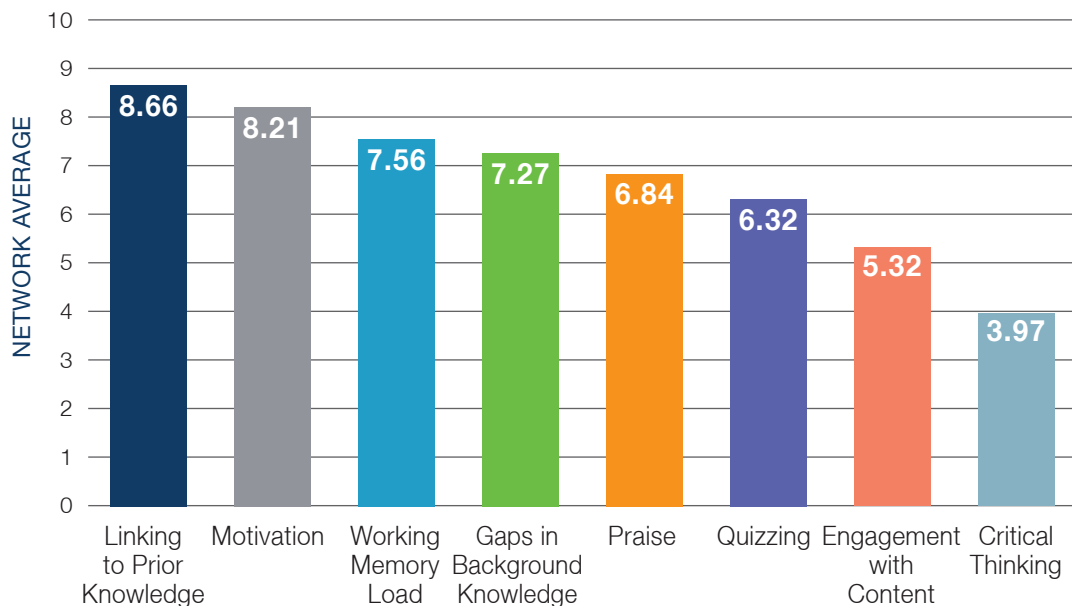
NOTE

These results show the unweighted average scores of 1,036 teacher-candidates on each belief item. The optimal ranking is 10 for each item.

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[5] For more on this topic, see Deans for Impact's digital publication *The Content of Thinking*, available here: **https://deansforimpact.org/content-of-thinking/**

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On the whole, we find this data encouraging. Across most areas, teacher-candidates hold beliefs that align with learning science in key areas, particularly around working memory and prior knowledge. For example, consider the following statement:

> *Helping students make links between new material and what they already know is one of the most important ways I can impact their ability to recall the information later.*

SCORE
▼
8.66
(10=optimal)

The fact that teacher-candidates so strongly agree with this is gratifying. But we see areas for improvement around beliefs as well. Consider the statement on the use of quizzes that we asked teacher-candidates to respond to:

> *Teachers should regularly quiz their students to understand what they know and support their retention of information.*

SCORE
▼
6.32
(10=optimal)

In aggregate, teacher-candidates tended to agree with this statement – but just barely. We'd like to see this change. The benefit of using quizzes to prompt effortful thinking by students is well established, and spacing such quizzes out over time leads to more durable learning.

5. Teacher-candidate understanding of learning science does not vary based on key categories we might expect.

One of the more surprising findings from our assessment is that there is little variation in performance by teacher-candidates across the LbSD Network, across a number of categories we might have expected to impact their performance.

For example, scores did not vary based on whether teacher-candidates had enrolled or completed a course in learning science. This accords with numerous conversations we've had with teacher-candidates who have described taking a single course on learning science (often labeled "education psychology"), usually at the beginning of their teacher preparation, that is otherwise disconnected to the rest of their coursework and clinical experiences. This is why one of the major aims of the LbSD Network is to see learning science as something that underpins all of teaching, rather than something separate from general pedagogical skill.

Interestingly, scores also didn't vary based on how far teacher-candidates have progressed in their student teaching – whether just starting or having already completed student teaching, or somewhere in between, teacher-candidates scored the same. Ideally, student teaching should provide future teachers with opportunities to practice and get feedback, and we might expect those who have completed student teaching to have more proficiency with making instructional decisions. Yet our data shows this isn't the case.

▼
Results don't vary by length of time in program, learning-science coursework, or by race, gender, or age.

Finally, at both the item-level and on the different dimensions presented in this report, scores did not vary based on teacher-candidate demographics, whether by race, gender, or age. Given that we are using data from this assessment to drive our improvement work with programs, we are pleased that this assessment does not seem to be systematically privileging one group of candidates over another based on demographic traits.

6. Teacher-educators in the LbSD Network do better at identifying learning-science principles in practice than just the principles in the abstract.

At Deans for Impact, we view our improvement work with educator-preparation programs as a shared learning journey. While the focus is always to improve the effectiveness of future teachers, we know from experience that all parties involved in educator preparation will need to develop new knowledge to make this happen.

This includes teacher-educators, the faculty and staff of educator-preparation programs responsible for preparing teacher-candidates. If we want teacher-candidates to know and apply learning science, they will need to be supported by teacher-educators who do both of these things, and can model learning-science-informed teaching.
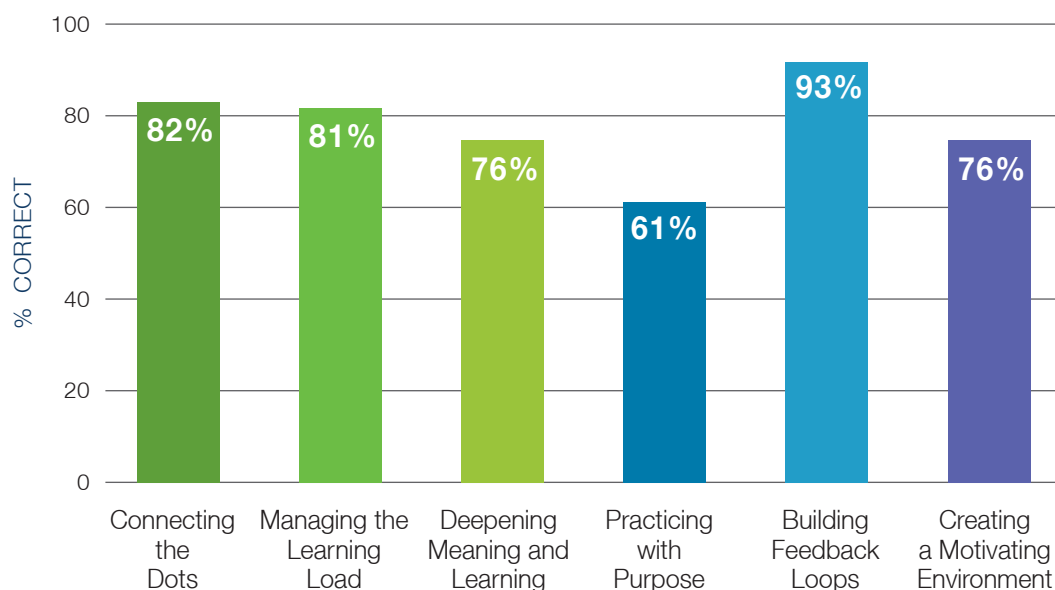
For that reason, we invited the participating teams of teacher-educators in the LbSD Network to (voluntarily) take the assessment, and nearly every teacher-educator participating in the LbSD Network did so. Using this data as a foundation, these same teacher-educators are conducting independent studies of learning-science research, forming discussion groups, and developing professional development sessions for other faculty. Here are the results:

Teacher-Educator Network Domain Averages
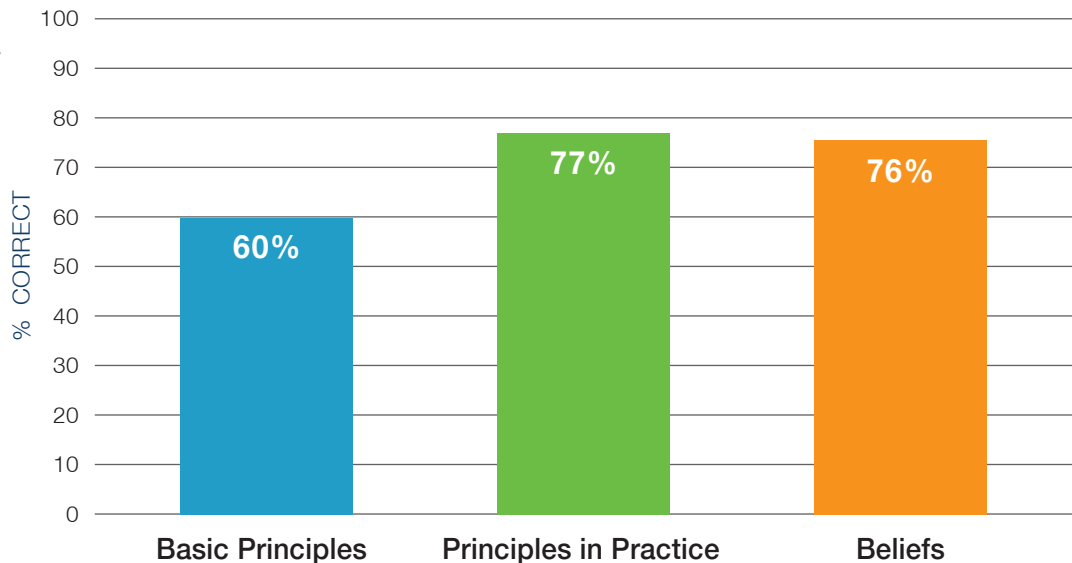
NOTE

These results show the unweighted average scores of teacher-educators on each assessment domain

Bar chart — % CORRECT by domain:
- Basic Principles: 60%
- Principles in Practice: 77%
- Beliefs: 76%

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Teacher-Educator Averages on LbSD Principles in Practice

Bar chart titled "Teacher-Educator Averages on LbSD Principles in Practice." Y-axis labeled "% CORRECT" from 0 to 100. Values: Connecting the Dots 82%, Managing the Learning Load 81%, Deepening Meaning and Learning 76%, Practicing with Purpose 61%, Building Feedback Loops 93%, Creating a Motivating Environment 76%.

Overall, we are encouraged by this data. Although many are convinced that the faculty of schools of education spend too much time with students pondering Dewey and Vygotsky, that doesn't align with the reality we've seen. Deans for Impact is a selective group, of course, but time and again we've been impressed with the thoughtfulness that the majority of teacher-educators we work with bring to their craft.

Our data set – and we will again underscore that this is a very small and not-at-all representative sample – affirms our experience. The teacher-educators we work with – ranging from tenured faculty to program administrators to field supervisors – are generally strong in identifying teaching practices that accord with principles of learning science, even if their understanding of the principles in abstract is not as deep. Our hunch is that learning science may thus be embraced by teacher-educators as providing a shared vocabulary for pedagogical practice.

Or as one faculty member said to us recently: "This is just good teaching."

We agree.

THE FUTURE OF LEARNING SCIENCE IN EDUCATOR PREPARATION

This report shares early insights from the Learning by Scientific Design Network. Since formally launching in Fall 2019, the six participating educator-preparation programs have undertaken a tremendous amount of work to transform how they prepare future teachers. This includes developing and administering the LbSD Assessment; identifying strengths and growth areas within their programs, building faculty knowledge of learning science; observing teacher-candidates to explore how knowledge of learning science can impact pedagogical practice; and examining coursework structure and field placements to determine how they might align with learning science as a focus.

So it's been a busy and productive six months. Here's what lies ahead:

First, programs will set ambitious, measurable benchmarks for improvement. This work is already underway, and some programs have already settled on specific goals, such as improving teacher-candidate scores on the "deepening meaning and learning" principle from 40% to 80-90%. To achieve this, programs will develop specific plans to make changes to coursework and field experiences.

Then, over the next academic year, programs participating in the Learning by Scientific Design Network will implement these changes. Deans for Impact will continue to serve in a support capacity, helping programs to manage the change process and stay true to their improvement goals. This will culminate in administering the learning-science assessment again in Spring 2021 to evaluate whether and how these programmatic changes have impacted teacher-candidate understanding of learning science.

In addition, Deans for Impact aspires to expand this work. As we go to press, we are actively developing plans to add additional programs that want to learn together with this first cohort of the LbSD Network. In time, we hope to have a broad, diverse, and growing number of programs working together to ensure the teachers they prepare begin their careers with a scientific understanding of how students learn.

One final comment. We publish this report fully aware of the risk that the data shared here may be interpreted in a negative light. We hope that impulse is resisted. As noted in the introduction to this report, we think the fact that some novice teachers begin their careers without understanding learning science is an eminently solvable problem. And the programs participating in the LbSD Network are trying to solve it. We are grateful that that they are sharing the story of their improvement efforts as they are underway.

This is what evidence-informed improvement in educator preparation looks like. We are excited to continue to learn together – and to grow this movement.

DEANS FOR IMPACT

APPENDIX

Learning by Scientific Design Advisory Board

To inform our learning-science work Deans for Impact has assembled an expert advisory group composed of researchers, teacher-educators, and teachers. The diverse expertise of the group ensures that the network is grounded in both the science of how children learn and the practical realities of teaching and learning in schools across the country. One of our advisors, Dr. Daniel Willingham of the University of Virginia, serves as a special advisor under contract to the LbSD Network.

LEARNING SCIENTISTS

- **Pooja Agarwal**
  Assistant Professor, Berklee College of Music;
  Founder of RetrievalPractice.org

- **Daniel Ansari**
  Professor and Canada Research Chair
  in Developmental Cognitive Neuroscience,
  University of Western Ontario

- **Anne Castles**
  Distinguished Professor of Cognitive Sciences,
  Macquarie University

- **Stephen Chew**
  Chair, Professor of Psychology,
  Samford University

- **John Dunlosky**
  Professor and Director of
  Science of Learning and Education Center,
  Kent State University

- **Regan Gurung**
  Professor, School of Psychological Science,
  Oregon State University

- **Daniel Willingham**
  Professor of Psychology,
  University of Virginia

TEACHER-EDUCATORS

- **Danielle Dennis**
  Director, University of Rhode Island School
  of Education

- **Julie Sloan**
  Director, Early Career Teaching Network,
  Boston Teacher Residency

- **Nakeshia Williams**
  Assistant Professor, Teacher Education,
  North Carolina A&T State University

- **Brianna Cullen Wilson**
  Learning Science and Continuous Improvement
  Specialist, Boston Teacher Residency

TEACHERS AND OTHERS

- **Patrice Bain**
  Co-author of *Powerful Teaching: Unleash
  the Science of Learning*

- **Paul Bruno**
  PhD candidate, University of Southern California
  Rossier School of Education

- **Blake Harvard**
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- **Dylan Kane**
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- **Callie Lowenstein**
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- **Dan Meyer**
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- **Michael Pershan**
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