

PSET Learning through Storyline Curriculum Development

by [Kelly Feille](#), University of Oklahoma

Abstract

Current approaches to science education emphasize authentic science learning experiences for students and center the learner as the driver of the classroom experience. One support to help pre- and in-service science teachers meet the goals of a student-centered classroom exists in the form of curricular materials. The storyline unit has the potential to be particularly beneficial as a tool for preservice science teacher education as it serves as a model structure for a student-centered science curriculum that aims to leverage student ideas and connected science learning experiences to facilitate authentic science learning. The innovative practice described in this article utilizes the storyline unit as a curricular tool to support preservice science teacher development through curricular design, evaluation, adaptation, and finally implementation. In grade-level teams of three to four, preservice elementary teachers (PSETs) select a Big Idea from Grades 3-6 to develop a storyline unit using provided tools and scaffolds (templates). The course concludes with grade-level teams launching their storyline through a peer-teaching session that includes the introduction of phenomena and elicitation of initial student ideas. Because of the heavy reliance on curricular materials for science teaching at the elementary level, supporting and investigating curricular role identity development of preservice elementary teachers is important. Engaging PSETs in the co-design of storyline units with an emphasis on evaluation of materials supports the development of a curricular role identity that can support ongoing learning through curriculum materials and the appropriate adaptation and enactment of high-quality instructional materials for their future students.

Current approaches to science education informed by A Framework for K-12 Science Education (National Research Council, 2012) and the Next Generation Science Standards (NGSS Lead States, 2013a) emphasize authentic science learning experiences for students and centering the learner as the driver of the classroom experience. Student-centered teaching and inquiry-driven classrooms often differ from the learning environments that teachers themselves experienced as learners (Davis, 2006; Windschitl et al., 2018). One support available for both pre- and inservice science teachers is curricular materials that center the learner and incorporate an inquiry-driven approach to science teaching. As generalists, elementary science teachers rely heavily on curricular materials (Forbes & Biggers, 2016; Forbes & Davis, 2011). However, for effective use of curricular materials, teachers should be ready to adapt the materials to support the needs of the students in their classroom and reflect the context of their learners (Barab & Luehmann, 2003; Davis, 2006;

Forbes & Biggers, 2016). While inservice teachers require support to make necessary pedagogical adaptations to their curricular materials (Forbes & Biggers, 2016), preservice teachers need an understanding of curriculum design and how to evaluate the quality and potential effectiveness of curricular materials in addition to learning to make similar adaptations in planning and practice (Davis, 2006).

Conceptual Framing

Elementary science methods coursework is the primary opportunity for preservice teachers to engage in the process of evaluating, designing, and implementing science curricula. Through intentionally designed experiences, the methods course can provide preservice teachers with experiences that will allow them to enter the classroom confident in their ability to enact curriculum to best meet their students' learning needs. One such intentional experience is the use of storyline curriculum development to support preservice teachers' development of curricular role identity.

Curricular Role Identity

Curricular role identity can help describe how teachers' individualized constructs influence how they may use curriculum materials for teaching (Forbes & Biggers, 2016). Teachers' relationships with curriculum include the process of curriculum design, evaluation and critique, adaptation, and enactment of those materials. A teacher's curricular role identity is a "composite representation of multiple activities teachers engage in" (Forbes & Davis, 2008, p. 929) that includes how they orient themselves towards the use of curriculum materials, how they may evaluate, adapt, and enact materials to support student learning, how contextual factors influence the use and adaptation of curricular materials, and finally their own perceptions of their ability to learn from curriculum materials (Forbes & Biggers, 2016, p. 134). Because of the heavy reliance on curricular materials for science teaching at the elementary level, supporting and investigating curricular role identity development of preservice elementary teachers is important. The innovative practice described here intends to support the curricular role identity of preservice elementary science teachers.

Storylines

A storyline approach to science curriculum is "designed with a trajectory from questions to investigations to ideas in which students partner with teachers to manage the trajectory of the knowledge building" (Reiser et al., 2021, p. 811). The storyline unit is one curricular response to reformed science teaching practices identified by the Framework and the NGSS (National Research Council, 2012; NGSS Lead States, 2013a). The storyline unit has the potential to be particularly beneficial as a tool for preservice science teacher education as it serves as a model structure for a student-centered science curriculum that aims to leverage student ideas and connected science learning experiences to facilitate authentic science learning and the construction of evidence-based explanations of scientific phenomenon. The

innovative practice described in this presentation utilizes the storyline unit as a curricular tool to support preservice science teacher development through curriculum design, evaluation, adaptation, and, finally, implementation.

Organization

The storyline design practice described in this manuscript spans a semester-long elementary science methods course at a large public university in the central United States. The elementary methods course is the second elementary science course students complete as elementary education majors. Students complete the methods course while concurrently enrolled in methods courses in literacy, mathematics, and social studies during their final year of studies in the semester preceding their teaching internship. Additionally, students are placed in an elementary classroom field placement, which they attend two days each week. Storyline design has been implemented in our elementary science methods course since Fall 2018, with revisions and improvements to the practice each semester. The practice described here was implemented in the 2023-2024 academic school year in two sections of elementary science methods with a total of 35 preservice elementary teachers (PSETs). In grade-level teams of three to four, PSETs select a *Big Idea* from Grades 3-6 to develop a storyline unit. They use provided tools and scaffolds (templates) to construct the unit and produce web-based curricular material. The course concludes with grade-level teams teaching the launch of their storyline to their peers by introducing phenomena and eliciting initial student ideas. The storyline design process includes several weeks of in- and out-of-class work and is broken down into four sequential steps and completed using provided templates (see Table 1).

Table 1
Storyline Design Steps

Storyline Design Step	Timing	Included Processes
Step 1 (Team)	Week 4 in class Due week 5 Revisions due week 8	Identify grade-level big ideas and 3-dimensional standards Construct Teacher Background and Content Explanation Identify Anchoring Phenomenon and driving question Storyline Launch Detailed Learning Plan
Step 2 (Team)	Week 7-8 in class Due week 9 Revisions due week 11	Develop summative assessment and evaluation tool Summative Assessment Detailed Learning Plan
Step 3 (Team)	Week 11 in class Due week 12 Revisions due week 14	Develop Lesson Sequence Develop lesson-level assessments and evaluation tools
Step 4 (Individual)	Due week 14 Revisions due Week 16	Lesson Sequence Detailed Learning Plans Peer review and revision of detailed learning plans
Finalization (Team)	Due week 16	Final publication of storyline on website Peer-teach storyline launch lesson High-quality instructional materials rubric assessment

Note: See supplemental files for templates

Step 1

PSETs are scaffolded through the use of a science framework developed by the state department of education as a tool for their storyline development. The OKScience Framework (Oklahoma State Department of Education, 2022) includes grade-level bundle analyses that suggest student actions, teacher actions, and key concepts (see Figure 1). Additionally, each bundle analysis includes a sample unit progression that suggests relevant phenomena, essential questions, evidence of student understanding, and a 3-dimensional narrative of potential classroom learning. Performance expectations are bundled and named using *Big Ideas* such as *matter*, *Earth's events*, and *ecosystems* as a few examples (see Table 2). Grade-level teams are free to choose the big idea their group is most interested in focusing on for their storyline development.

Figure 1
Sample Bundle Analysis

2020 Grade 2: Matter Bundle Analysis

Key - Blue = indicates a science and engineering practice (SEP) - Green = indicates a crosscutting concept (CCC) * = indicates a standard with integrated engineering practices and/or disciplinary core ideas <i>Guide to the Science Bundle Analyses</i>	
Grade 2: Matter 2.PS.1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. 2.PS.2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* 2.PS.3 Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. 2.PS.4 Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.	
In a Nutshell Matter is all around us and can change and exist in different states, including solids and liquids, depending on its temperature. Using this information, students plan and conduct investigations to describe and classify materials based on their properties (characteristics). Students collect and examine data to determine that materials can have different properties (ex: flexibility, hardness, texture) that can determine how that material might be used. Students make observations of objects that are made of parts to collect evidence that parts can be assembled to create a variety of new objects. Through their observations of matter, students can collect evidence to make arguments that sometimes changing from solid to liquid or liquid to solid can be reversed by heating or cooling.	
Student Actions - Work collaboratively to plan and conduct investigations to describe observable patterns of solids and liquids caused by heating or cooling them. - Gather information and use evidence to describe and classify matter by its observable properties. - Work collaboratively to plan and conduct investigations to test different materials for different purposes. - Analyze data from testing to discover which materials have properties that are best suited for a specific purpose. - Observe and analyze properties of materials in the natural world and use evidence to compare those properties to human made products. - Make observations (firsthand or from media) to construct an explanation that a great variety of objects can be broken apart into a small set of pieces and used to build larger objects which may differ in shape. - Construct an argument with evidence that heating or cooling a substance may cause changes that can be observed. - Construct an argument with evidence that changes caused by heating or cooling a substance can sometimes be reversed, and sometimes cannot be reversed.	Teacher Actions - Provide opportunities and supplies for students to plan and conduct investigations to describe observable patterns of solids and liquids caused by heating and cooling them. - Provide different types of materials (matter) students can use to observe and classify by observable properties. - Provide materials and guidance to help students plan and carry out investigations that compare different materials used for different purposes. - Provide opportunities for students to analyze data from testing materials to discover properties best suited for a material's specific purpose. - Support students in testing materials and analyzing their properties to communicate which materials are best suited for a specific purpose. - Provide opportunities and supplies for observations, first hand or through grade appropriate media, to construct an explanation that a great variety of objects can be broken apart into a small set of pieces and used to build larger objects which may differ in shape. - Assist students in using evidence from investigations to support a claim (argument) that heating or cooling a substance may cause changes that can be observed. - Assist students in using evidence from investigations to support a claim (argument) that changes caused by heating or cooling a substance can sometimes be reversed, and sometimes cannot be reversed.
Key Concepts Structure and Properties of Matter - Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. - Matter can be described and classified by its observable properties. - Different properties are suited to different purposes. - Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. - A great variety of objects can be built up from a small set of pieces. Chemical Reactions - Heating or cooling a substance may cause changes that can be observed. - Sometimes these changes are reversible, and sometimes they are not. Influence of Engineering, Technology, and Science on Society and the Natural World: - Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world.	Misconceptions - Materials can only exhibit properties of one state of matter. - Melting and dissolving are the same thing. - Solids are matter, but liquids and gases are not. - When matter changes states, it is a new substance.

(Oklahoma State Department of Education, 2022)

Table 2
Grade-level Big Ideas

Grade 3	Grade 4	Grade 5	Grade 6
Magnets (3.PS3.2, 3.PS2.4) Motion (3.PS2.1, 3.PS2.2) Environment and Organisms (3.LS4.1, 3.LS4.3, 3.LS4.4) Reproduction and Traits (3.LS1.1, 3.LS3.1, 3.LS3.2) Survival (3.LS2.1, 3.LS4.2) Weather and Climate (3.ESS2.1, 3.ESS2.2, 3.ESS3.1)	Converting Energy (4.PS3.2, 4.PS3.4) Motion (4.PS3.1, 4.PS3.3) Organisms (4.LS1.1, 4.LS1.2, 4.PS4.2) Information Transfer (4.PS4.1, 4.PS4.3) Earth's Features (4.ESS1.1, 4.ESS2.1, 4.ESS2.2) Human Environment Interactions (4.ESS3.1, 4.ESS3.2)	Properties of Matter (5.PS1.1, 5.PS1.3) Changes to Matter (5.PS1.2, 5.PS1.4) Matter and Energy Flow in Organisms and Ecosystems (5.LS1.1, 5.LS2.1, 5.PS3.1) Earth Materials and Systems (5.ESS2.1, 5.ESS2.2) Earth and the Solar System (5.ESS1.1, 5.ESS1.2, 5.PS2.1) Effects of Human Interactions on Earth Systems (5.LS2.2, 5.ESS3.1)	Kinetic Energy as Temperature and Waves (6.PS1.4, 6.PS3.3, 6.PS3.4, 6.PS4.2) From Molecules to Organisms: Structures and Processes (6.LS1.1, 6.LS1.2, 6.LS1.3, 6.LS1.8) Energy Flow and Earth Processes (6.ESS1.4, 6.ESS2.1, 6.ESS2.2, 6.ESS2.3) Earth Systems and Interactions (6.ESS2.4, 6.ESS2.5, 6.ESS2.6, 6.ESS3.2)

(Oklahoma State Department of Education, 2022)

PSETs navigate the OKScience site (Oklahoma State Department of Education, 2022) to begin to construct a concept map of the prominent scientific concepts and sub-topics related to their selected Big Idea. Arranging these ideas using a concept map allows PSETs to

identify how topics are related and how scientific understandings work together to explain a broader scientific phenomenon or idea. To support PSET conceptual understanding, they utilize resources such as the NGSS videos from The Wonder of Science (Anderson, n.d.) as they work together to construct the *Teacher Background* content explanation for the storyline unit (see Figure 2). Once PSETs have a conceptually accurate understanding of the Big Idea for their unit and a foundational progression of learning, they brainstorm and select an anchoring phenomenon and driving question.

Figure 2
Step 1 Brainstorming Teacher Background

Storyline Plan Step 1

Standard Alignment and Teacher Background

Grade level and Big Idea from the OKScienceFramework With your grade level team, select a Unit Bundle (Big Idea) to focus on for this project. Grade 3 Grade 4 Grade 5 Grade 6 Identify the grade level and selected Big Idea below.	
OAS-S Performance Expectations (PEs) associated with the Big Idea. Copy and paste the entire Performance Expectations associated with the Big Idea here.	
Next, identify the elements from the foundation boxes for the PE(s). Do not just list the DCI or CCC. Be sure to include all descriptive text as well. You may copy and paste these directly from the OAS-S.	
Disciplinary Core Ideas (DCI)	Cross-cutting Concepts (CCC)
Science and Engineering Practices (SEP)	
BRAINSTORM <i>What ideas from the curriculum and the OAS-S/NGSS seem the most central? What are the most important pieces that your students need to understand to make sense of the big idea, and why? Review each section of your Grade Level Bundle Analysis page (Performance Expectations, "In a Nutshell", Student and Teacher Actions, Key Concepts, and Misconceptions) Consider the science content described throughout.</i> <i>Brainstorm the most prominent ideas that are mentioned in the text and write each idea on a notecard (no more than 12). Use the notecards to construct a concept map of your Big Idea. What sub-topics seem the most important? What sub-topics seem to lead to another one? Arrange the sub-topics in a way that helps you see the content storyline of your Big Idea.</i> <i>For each DCI you identified above, watch the teacher-information videos found on the Wonder of Science website and review the vertical progression in your NSTA quick guide. How do the relevant big ideas progress through the grade levels? In other words, how does what students learn in this unit support them as they move towards high school science?</i>	
Teacher Background and Detailed Content Explanation	

To conclude Step 1 as a team, PSETs construct a detailed learning plan that launches the unit through the introduction of the anchoring phenomena and elicits students' initial ideas (see Figure 3). The instructional and student tasks are written so that any PSET in the class can follow the plan. The plan includes suggested teacher questions that probe students and allow them to explain their thinking. For each instructional task, the learning plan identifies formal and informal opportunities for students to demonstrate their understanding and suggests scaffolding tools and modifications for students with diverse learning needs (i.e., SPED, ELL, GT).

Figure 3
Detailed Learning Plan Template

Storyline Detailed Learning Plan Template

Essential Question What is an essential question for the lesson? In other words, what question would your students want to answer while engaging in the planned learning experiences?			
Learning Plan Use as many or as few rows as you need to describe the instructional and student tasks used to introduce the phenomena with the above considerations. You must also include the ways in which students can provide evidence of learning ("Assessment Opportunities") and how you will scaffold for students who are ELL and with additional special learning needs (SPED and GT). The detailed learning plan should be written so that another teacher could pick it up and teach it as you imagine it.			
Task Indicate what is the main objective of each task	Grouping How will you arrange the class? In one learning task, students may move in and out of class formations. Mark all that apply.	Instructional and Student Tasks These should be written clearly and detailed enough that another teacher could follow them easily. Include all Teacher Questions and color them red. Your questions should probe students to allow them to explain their thinking and elicit understanding. Avoid closed/single response questions.	Assessment Opportunities What are both the formal and <i>informal</i> opportunities students have to demonstrate their new understanding? <i>Scaffolding tools for ELL and students with special learning needs. How will support students who need help or extension for each task?</i>
Introduce ☐ Elicit ideas ☐ Explore ☐ Explain ☐	☐ Individual ☐ Pairs ☐ Small Groups ☐ Whole Class		(Replace this text with assessment opportunities) (Replace this text with scaffolding tools/actions)
Introduce ☐ Elicit ideas ☐ Explore ☐ Explain ☐	☐ Individual ☐ Pairs ☐ Small Groups ☐ Whole Class		(Replace this text with assessment opportunities) (Replace this text with scaffolding tools/actions)

Step 2

At this point, PSETs refer to the NGSS evidence statements (NGSS Lead States, 2013b) and OKScience Framework evidence of student learning to suggest a unit summative assessment and method of evaluation of student work (e.g., rubric, checklist, etc.). The emphasis of the summative assessment should be on students constructing an explanation of the anchoring phenomenon and answering the driving question. PSETs identify

opportunities for assessment that allow for a 3-dimensional student demonstration of knowledge and tend to avoid pencil and paper-type tasks in favor of performance-based assessment tools (see Figure 4).

Figure 4
Summative Assessment Task Design

Storyline Step 2

Summative Assessment Task

BRAINSTORM <i>Review the evidence statements for the unit Performance Expectations you identified above. Using the evidence statements, your understanding of the content, and the scientific explanation for the phenomena/answer to the driving question. How will you evaluate student evidence of learning? (e.g. rubric, checklist, etc) Be sure to use the evidence statements, performance expectations, and accurate scientific explanations while you construct your evaluation tool.</i>
Summative Assessment Task
Summative Assessment Evaluation

To conclude Step 2, grade-level teams develop a detailed learning plan for facilitating the summative assessment. Like in Step 1, the learning plan should be written considering teacher actions and probing questions, student actions and appropriate scaffolding tools, and attention to diverse learning needs (see Figure 3). The detailed learning plan for the assessment serves as the final lesson of the storyline.

Step 3

With an established conceptual map for the unit and a summative assessment end goal, PSETs begin to brainstorm a sequence of learning tasks. As a grade-level team, PSETs identify a three- or four-lesson sequence that will support student development of an explanation of the anchoring phenomenon and answer to the unit driving question. Within each lesson sequence, PSETs describe a lesson essential question, additional supporting phenomenon (if applicable), science and engineering practices students will engage in, what

students will figure out (referring to the supported DCI and CCC), and a learning goal for the sequence. A brief description of the lesson is developed, as well as a student assessment task and evaluation tool. PSETs are asked to consider and emphasize how each lesson sequence builds and supports learners as they construct evidence-based explanations of the unit's driving question (see Figure 5)

Figure 5
Designing a Sequence of Learning Tasks

Step 3

A sequence of learning tasks				
Review the 3-Dimensional Narratives provided in the OKSci Instructional Resources for your Unit and consider the scientific explanation for your phenomenon and driving question you developed in Step 1. In the spaces below, describe 3-4 lesson sequences that will support students as they engage in your driving question. You are encouraged to use the OKSci Instructional Resources as inspiration, however the tasks you describe should relate to your chosen phenomenon and driving question. Note: Use only the amount of spaces you need. Grade 3 Grade 4 Grade 5 Grade 6				
Lesson Sequence 1 Author:				
Essential Question for the Lesson	Supporting Phenomenon	Science & Engineering Practices	What students will figure out (DCI & CCC)	Learning Goal
Description of Lesson				
•				
How does this lesson sequence support students as they construct an evidence-based explanation of the Driving Question of the unit?				
Review the learning goal for the lesson sequence. Using the evidence statements for your storyline Performance Expectations, your understanding of the content, and the scientific explanation for the supporting phenomena/answer to the essential question for the lesson sequence: <i>What is an assessment task that students should be able to complete at the end of this lesson sequence?</i>				
How will you evaluate student evidence of learning? (e.g. rubric, checklist, etc) Construct a draft of your evaluation tool below. Be sure to use the evidence statements, performance expectations, and accurate scientific explanations while you construct your evaluation tool.				

Step 4

Once the storyline lesson sequence planning is complete, grade-level teams divide up the storyline lesson sequence to construct detailed learning plans as individuals (see Figure 3). Multiple rounds of peer review and revision help to ensure that the learning plans align with the expectations of the grade-level team and support student construction of evidence-based explanations of the unit driving question. In this step, grade-level teams provide the first round of peer review to ensure that constructed learning plans fit within the team's goals for the storyline unit. The second round of peer review is conducted by a classmate outside of the grade level team to ensure the plan is written clearly and with sufficient detail.

To identify appropriate teaching and learning tasks, PSETs refer to the OKScience Framework, existing curricular materials both in text and online, and various resources such as Wonder of Science (Anderson, n.d.) and NSTA (National Science Teaching Association, 2023). This task encourages PSETs to identify and critically evaluate the appropriateness of science curriculum materials as they adapt learning experiences to align with the goals of their lesson sequence and overall storyline unit. This process provides PSETs with an opportunity to practice evaluation of curriculum materials as they assess whether activities are appropriate for their learning objectives and storyline sequence. Additionally, PSETs practice adapting existing curriculum materials to fit the needs of the storyline sequence, further supporting the development of their curricular role identity.

Finalization

After peer review and revisions are completed for all lesson sequences, grade-level teams finalize their storylines for web-based publication on a Google Site hosted by the course instructor. Each grade level team has access to a template webpage that they edit to include a title for the storyline, the science academic standards addressed throughout the storyline, the summative assessment and storyline overview, a description of the anchoring phenomenon, and finally, the detailed learning plans included in the storyline. Grade-level teams provide a summary overview of each lesson of the storyline, and the complete detailed learning plan is linked as a Google Doc for others to access. An example of a grade-level webpage is included in the supplementary materials for this article.

As a means to introduce each constructed storyline to the class, grade-level teams facilitate the initial lesson sequence of their storyline, where the anchoring phenomenon is introduced, and initial understandings are elicited from the class. This peer-teaching experience emphasizes the pedagogical practices of centering science learning on phenomena, leveraging questions as tools to elicit student knowledge, and structuring a classroom community that values the contributions of all students as drivers of knowledge-building and sense-making practices.

Finally, PSETs apply their understanding as they evaluate their own grade-level storyline. Using a rubric adapted from the Oklahoma State Department of Education (Oklahoma State Department of Education, 2021), PSETs evaluate completed storylines for 1) alignment to

standards, learning progressions, and student-centered practices, 2) equity, 3) instructional support and assessment, and 4) access and technology.

Contributions

Through participating in the storyline unit development described in this innovative practice, PSETs have the opportunity to develop a curricular role identity more commonly associated with experienced practicing teachers through curriculum design, evaluation, critique, and adaptation of existing curriculum materials, and finally, enactment of a piece of their designed storyline sequence. (Forbes & Davis, 2008). The storyline development steps and intentional emphasis on aligned learning goals help PSETs focus on what their designed curriculum asks students to know and do (Penuel et al., 2022). While most practicing teachers are not curriculum developers, enacting high-quality instructional materials requires teachers to participate in the curriculum design process through evaluation and adaptation of curriculum materials. Engaging PSETs in the co-design of storyline units with an emphasis on the evaluation of materials facilitates the development of a curricular role identity that can support ongoing learning through curriculum materials and the appropriate adaptation and enactment of high-quality instructional materials for their future students.

Upon completion of the storyline unit, PSETs are able to critically evaluate their own as well as professionally developed curriculum materials. As part of their final evaluation of the storyline unit, students are asked to reflect on the process. Comments from student reflections help to describe the evidence of the success of the storyline design in the elementary science methods course. The experience helps PSETs consider planning for student learning, “I have learned how important it is to keep students engaged by thoughtfully planning lessons and activities. Activities should be hands-on and allow students to discover a small piece of the overall picture gradually” (Student comment). By emphasizing a student-centered approach, PSETs began to understand the power of student autonomy.

“With Step 4, I came to understand that by allowing the student autonomy, there is more room for engagement and understanding. I think that at the beginning of Step 4, I was trying to get to the learning goal too fast. Instead of breaking down each part and having more detail for higher understanding, I wanted to get to showing the learning goal in the lesson too soon which stops students from engaging in any kind of inquiry” (Student comment).

Additionally, recognizing students’ own funds of knowledge was emphasized.

“I would try to stimulate the students’ funds of knowledge in every planning. This way the students could begin each activity feeling engaged and safe to explore their ideas and the concepts through questioning and trial-and-error. I feel it is important to get students activating these traits/emotions during the launch of the lesson and try and carry them throughout because it acts as an additional tethering point for the information students are

learning, in turn building stronger neural pathways for future recall. I believe my experiences allow us as a class (myself included) to feel open to brainstorm and then continue to develop and change those ideas as more information is attained through exploration and observation” (Student comment).

Finally, engaging in the storyline unit design, evaluation, and enactment helps PSETs see how science teaching can and perhaps should be distinct from the ways they experienced science as learners.

“I think my plans follow a natural learning progression and are formatted in ways that can stimulate students to think deeper and make more connections to what they are learning. These are all things that I think are important for good science educators to engage students in/with. These experiences are also inspired by how I would have liked to engage with learning science and these science concepts in school. However, they do not reflect much of my past experiences as a science learner beyond this class” (Student comment).

Future work related to this innovation includes investigating the impact on PSET curricular role identity, comparative analysis of the application of the high-quality instructional materials rubric, and descriptive analysis of the features of science teaching and learning PSETs incorporate into their constructed storyline units.

Relevance to Science Teacher Education

This innovative practice provides preservice teachers the opportunity to engage with high-quality instructional materials in a storyline format through a curricular design, critique and evaluation, and implementation. By emphasizing and supporting curricular role identity development, this experience can help better prepare PSETs to actively engage in the adaptation and implementation of high-quality instructional materials in their future classrooms. Because curricular materials play an extensive role in science teaching at the elementary level, it is vital for the preservice teacher experience to include support in the process of curriculum design in its entirety from beginning to classroom enactment.

Supplemental Files

[Feille-Storyline-Plan-Template.pdf](#)

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