The Science Around Me: Creating Pre-Service Teachers' Portfolio Focused on Developing Scientific Questions and Explaining Relevance

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Abstract

Pre-service teachers (PSTs) in elementary and middle grades teacher preparation programs may not feel comfortable with teaching science content and developing science lessons. To encourage and support elementary and middle grades pre-service teachers (PSTs) growth, interest, and confidence in teaching science, I created a portfolio assignment called The Science Around Me that focused on the PSTs' developing scientific questions and explaining phenomena relevance. PSTs utilized photographs and videos from their own lives and experiences. The portfolio documents PSTs ability to develop scientific questions (in the manner of Cruz-Guzman, 2017) that could potentially lead to sensemaking investigations using the Science and Engineering Practices (SEPs) and explain the relevance of scientific phenomena to their future students at three different levels. The scope of tasks increased each week as students were given constant formative guidance and feedback. Student feedback was generally positive and helped their ability to "see" the science in their own lives, generate questions about it, and explain its relevance. If PSTs can develop these pedagogical skills, this ability can be transferred to their future students to recognize the science around them in their lives.

Introduction

Elementary and middle grades teachers play a critical role in fostering a love and interest in science in their students (Bjeknes et al, 2024). This means teachers' focus should be with providing engaging activities and investigations using three-dimensional (3D) learning with a focus on science and engineering practices, or SEPs, aligning with a disciplinary core idea (DCI), and guided by a theme or crosscutting concept (CCC) (NGSS Lead States, 2013). Teaching science involves a level of diving into complex concepts and introducing factual information. The memorization of facts can rarely be interactive, hands-on, and memorable. Science should not be taught as if it were inaccessible, unattainable, and outside of our day-to-day existence. The advent of NGSS has shifted the paradigm of science teaching to more investigatory and experiential so that students can make sense of the natural world and the phenomena that abound within it. Learning science needs to be participatory, with more personal and concrete experiences facilitated by the teacher that promote deeper and broader understanding (Smith et al, 2025). The great X-ray crystallographer and arguably true discoverer of DNA's structure, Rosalind Franklin, said, "Science and everyday life cannot and should not be separated." (Rosenfeld, 2003). Thus, in addition to designing and implementing three-dimensional lessons that allow for sensemaking, teachers should be aware and attending to two other pedagogical components: 1) the ability to ask scientific questions that activate student interest and engagement in an imminent lesson and investigation, and 2) the ability to explicitly explain why the phenomenon is relevant (Stuckey, 2013; Vale, 2013). To this end, I created a project task, The Science Around Me, which is an electronic "portfolio" that allows pre-service teachers (PSTs) to document and practice formulating scientific questions about the everyday places and things within their own lives which could lead to an investigation, and to be able to explain the different phenomena's relevance and meaningfulness, as if explaining it to their own students, a task they may expect to do throughout their teaching career

PSTs and Science Teaching: Asking Questions to Investigate Phenomena

Recent scholarship has shown that science teaching should be grounded in constructivism, which will enable young learners to think more critically (NRC, 2011; NSTA, 2020). However, some PSTs at the early or middle level may lack self-efficacy in teaching science and do not identify as science teachers, possibly referring to themselves as 'not a science person' (Gunning & Mensah, 2011; Palmer, 2006). A consequence of this self-perception may be that their subsequent lessons make more use of textbooks, copied packets and scripts from pre-packaged curricula (Loughran, 2013; Kinskey & Zeidler, 2020). By engaging in hands-on 3D investigations, PSTs may begin to understand and acquire a more student-centered, inquiry-based approach to science teaching with a more positive and less anxious attitude about teaching science (Yesilyurt, 2022; NSTA, 2018). But they also need to develop their teaching ability by taking science content courses and teaching methods classes (with and without field experience components) that engage the PSTs in lessons that are 1) standards-based (NGSS or state equivalent), and 2) are three-dimensional: integrating the Disciplinary Core Idea (DCI), strong use of Science and Engineering Practices (SEPs), and guided by the theme or Cross Cutting Concept (CCC) (NGSS, 2013).

Similarly, instructors (including myself) often use journals or reflective logs for their PSTs to observe and track understanding and changes in growth mindset about teaching science. While useful in the silo of a course, journaling about what is learned in a science methods course is not necessarily correlated to the PSTs' curiosity about scientific phenomena and self-efficacy in teaching science (Antink-Meyer et al, 2023). Instruction in lesson planning and the complexity of science teaching is essential to dismantle these ideas, some of which may have been obtained in PSTs' own K-12 science instruction (Muimongkol et al., 2021).

One of the SEPs – the first one listed – is Asking Questions. As teachers of science, we want students to ask questions about an array of phenomena. Teachers are a critical mediator in the delivery of these questions (McDonald et al., 2014; Windschitl, 2003). But there is a difference in posing questions that are interesting about any scientific phenomena and those questions that are a springboard to conduct a scientific investigation (and employing the other SEPs). These questions should be “higher order” (on Bloom’s Taxonomy) and induce critical and analytical thinking. Cruz-Guzman et al. (2020) examined questioning ability among PSTs and found that their question-forming ability was stronger in certain content areas when it came to making predictive questions and relating change in variables, and the properties of the variable itself, possibly due to the PSTs’ self-efficacy with the content area (phases of matter, plants). Cruz-Guzman et al. (2017) developed a taxonomy of question order (low to high) to determine and measure teachers’ ability to develop questions (see Table 1). These categories begin with conceptual and progress through descriptive, comparative, causal, predictive, and variable relationships.

Table 1

Taxonomy of Questions (from Cruz-Guzman et al, 2017)

Question Type	Description	Example
Conceptual	Seeks generalization or definition	What is a mineral? What are tornadoes like?
Exploratory/ Descriptive	Encourages a description or exploration	What will happen if you mix paint colors? What is the inside of an egg like?
Comparative	Differentiating variables in groups or contexts - more descriptive than investigative	What are similarities and differences between reptiles and amphibians? What freezes faster, water or milk?
Causal	Has a causal explanation, asks Why?	Why does the Sun appear reddish at sunset? Why do stars twinkle but planets do not?
Verification	Needs check to be made	How could you test whether water temperature affects fish behavior? What would you study to examine which food molds fastest?
Predictive	Situational occurrence (If…)	What would happen if we changed the acidity of the water we added to the plant? What would happen if we used a bigger or different shape magnet to attract items?
Relationships	Association, causal, interaction of two or more variables	How does the size of a shadow change over the course of a day as the Sun changes position? How does a change in mass affect an object's ability to overcome friction and start moving?

Introducing an ongoing task focused on formulating scientific questions and allowing PSTs to practice and improve upon developing and writing scientific questions that can encourage and initiate an investigation into a particular phenomenon may help to improve their understanding and self-efficacy, as per Palmer (2006).

Explaining Relevance and Why the Science Matters

The concept of relevance may be more abstract and encompass a larger range of meaning, making tackling this skill for PSTs every bit as challenging as formulating questions. Interpretation of relevance extends from being synonymous with "interest" or "interesting," with "interest" referring to student interest, and should not to be confused with enjoyment (Stuckey et al., 2013). The closest term to relevance may be "meaningful" or "meaningfulness." Relevance as meaningful, or students making meaning of the science in their exploration of the phenomena, is closely aligned with the writings of Dewey (1986) and Bruner (1997). But Stuckey et al. (2013) argue that relevance, or meaningfulness, should be taught in terms of *consequences*. A consequence can be viewed and explained by a teacher to their students as the impact on their everyday life, the personal, physical, and material world that they experience. By explicitly describing the consequence or impact upon a student's life first and foremost, as well as all people, all living things, and the planet they live on, the opportunity for that student's affective traits, like motivation, attitude toward learning, and self-efficacy, may increase. Their sensemaking process may be more successful (Brownell et al., 2013).

Context of the Science Around Me Portfolio

The implementation of this project took place at a large public university in southeastern Pennsylvania. The university started in 1871 as a teachers' college (normal school) and, as the teacher preparation program for all levels, remains a program with a substantive student population. Science methods is a semester (15-week) long required course which is generally made up of juniors and seniors in our education program who are preparing to be elementary and middle grades teachers. Although the middle grades PSTs declare concentrations within the major, all are required to take this due to the nature and range of their certification. The course is the only one in our teacher education program that is focused specifically on the methods of science teaching. In general, the enrollment in the elementary version is capped at 32 students (with usually four sections per semester), and the middle grades version is capped at 24 students (enrollment usually ranges from 14 to 22). The middle grades prep students have a range of subject concentrations: mathematics, language arts, social studies, special education, with science usually being the least. These students have many opportunities to be in schools with K-8 students throughout their time in the major program, but the elementary version of this course has no field component to it. The middle grades section does require 15 hours of field work in a middle school science (or STEM or technology-engineering) classroom.

This assignment evolved out of the realization that PSTs view science as disconnected and siloed, and as something outside the regular school curriculum, which is heavily reading, writing, and mathematics. I wanted to create an assignment to reinforce that science, scientific phenomena, and processes are not something removed from my students' lives, but very much embedded within them (Radloff, 2018). My students' job was to step back and reflect on what they do throughout the day (school, work, hobbies, recreation, vacation) or where they have been at any time and apply, asking scientific questions about a picture or video from their own life – one that could investigate a phenomenon tied to a particular DCI or state standard.

I also wanted students to be able to proficiently explain how that phenomenon – the process or related content – was relevant. Relevance occurs on different tiers or aspects: 1) the individual student, 2) society/humanity as a whole, and 3) the Earth (and its systems). Any one of these tiers is important for a PST to be able to verbalize this explicitly to their own future students. And so out of this was the genesis of the Science Around Me portfolio.

The Portfolio

Many people have pictures and videos of themselves at various points and places in their life. Sharing a bit of ourselves with our students is important in building relationships and doing that through pictures and video is one way to do so, as young learners, including the elementary and middle grades students that my PSTs will teach, can relate to the visual component of a lesson (Yasin & Parisu, 2025; Guo et al., 2020).

The selection of pictures or video over the course of the semester is to document PSTs' ability to 1) formulate scientific questions (questions that can lead to potential investigations that incorporate the SEPs (science practices), and 2) to describe or explain how different phenomena are relevant (i.e., to students, society, and Earth and its systems or other living or non-living things). This is an opportunity for PSTs to show growth and a growth mindset and ability as a teacher and teacher of science, and in lesson plan development and delivery.

During the first two class sessions, the PSTs are presented and given examples of scientific questions and what factors make for “good” questions (open, descriptive, exploratory, comparative, cause-effect, predictive, considering variables)(Cruz-Guzman et al., 2017). They also practice this skill during class immediately before they embark on creating their portfolio. I show a short video from my own personal albums, including one of me playing fetch with my dog at a dog park, or of the waterfalls in Iceland, or axe-throwing at a recreation center. The students generate one scientific question about what they are watching, using the guidelines from the examples of good questions. They then share out first in small groups and try to identify the type of question they created. I formatively assess their work as well.

The PSTs generate their portfolio by creating a slideshow using Google Slides. This slideshow is shared with me in a folder where I can access each student’s slideshow. Students allow me editing privileges so that I can provide feedback upon reviewing their entries. Each week for about the next 9-10 weeks, each student gathers a single visual (either a personal picture or short video) that represents or displays something scientific in their surroundings. Because these are pictures from the everyday life of a student, there is the likelihood that future students will share some commonality or learn something new from the picture/video. Each week for the next several weeks, the students add a new page to their slideshow, and the portfolio grows with each successive addition.

Many students who are PSTs have plenty of pictures and videos on their own phones or laptops, or from their social media, taken at different points and places throughout their lives. The pictures do not have to be current, as there are some students who include pictures of themselves as young children, often with family members included. For their first entry, they add one picture (or embed a short video [10-30 seconds]) onto the slide page and then include one scientific question about one aspect of what is in the picture that could be investigated empirically, and data could be collected. This question is also displayed on the slide.

Other components are also required. PSTs must be able to identify a single standard from our state standards, which are commonly called the STEELS (Science, Technology, Engineering, Environmental Literacy, and Sustainability), that is connected to the phenomenon they identify in their first picture or video. Also, initially, they must identify one SEP, apart from Asking Questions, and briefly explain how they would implement it in an investigation to answer the question they developed. This format remains for at least two weeks. By weeks 3 or 4 of their entry, the number of questions and the number of SEPs increases to two, so that the PSTs are able to expand their question development skills and their observation of what is in their picture, and apply the different SEPs to a potential investigation

The PSTs must also create a statement of relevance starting with their first entry. I ask them to write this as if they were actually saying it to their own young students, imagining that a student or students in the class asked them, “Why do we have to know/learn this?” They are expected to include how it relates to the three tiers described earlier (student, society, Earth/Earth systems).

As the semester progresses, one more piece is added as instruction and practice have reached that point, and that is the Crosscutting Concept (CCC). For this component, they identify which CCC they would use as their theme and explain how it would apply to the phenomenon and investigation in their picture. By the last 3 entries (of approximately 9 or 10), their slide entry must include the picture or video, up to 4 different questions, 4 different SEPs, a STEELS, a CCC, and a relevance statement. The chosen SEPs and the CCC required explanation as to how and what students would be doing in the investigation, and how the interacting CCC provides the overarching theme for the lesson. Figure 1 illustrates the difference in entry requirements between an early entry and a later entry. The requirements provided to the students for each week’s entry are in the Supplemental files.

Figure 1

Examples of weekly tasks from different points in the semester showing increased expectations and components

WEEK 1

1 photo/short video

1 scientific question

1 STEELS

2 SEPs you would use to answer your question – and explain what you would have the students do for that SEP

Relevance explanation: 1) to them, 2) society, and 3) Earth and all it's made of

WEEK 8

1 photo/short video

4 different scientific questions based on different things in your photo/video

2 STEELS (should be from different domains)

1 (different) SEP for each question - what you would use to answer your question – explain what you and the students would do for that SEP and question

1 CCC - identify which CCC would be the theme for one of your investigations and why/how it would be engaged

Relevance explanation: 1) to them, 2) society, and 3) Earth and all it's made of

The PSTs' portfolios and subsequent reflection logs were collected and explored for this work. Specifically, they were reviewed for general attitudes and sense of personal growth and understanding in PSTs' abilities to formulate questions using Cruz-Guzman (et al., 2017) as a lens, as well as PSTs' attention to relevancy (Stuckey et al., 2013) (e.g., how PSTs discussed connections between the portfolio and their chosen standards; across tiers). Random examples of student responses (both early and middle grades) from the reflection logs are provided below, and show a general positive affect and efficacy in their ability and understanding of the importance of these practices.

Project Entries and Evaluation

There are many commonalities in the pictures that the PSTs select for their entries. Vacation pictures are abundant, often these include pictures of a beach, the ocean, waves, as well as a sunset. Family pets appear in nearly every student's portfolio, as do pictures of their homes – usually the outdoor vegetation – trees, flowers, gardens, and lawns. Some weeks, there are pictures of the student's family members, with the accompanying questions often relating to genetics and traits. Pictures taken from airplanes are common – with the student noticing the wings, the land below, and the surrounding clouds. Other regular entries are firework displays, cars (usually theirs), amusement parks, weather (snow, rain, storms), nature (parks, rivers/waterfalls, rocks), buildings on and off campus, food and restaurants, and sports and recreation – sometimes themselves or candid shots of our university athletes in competition. Figure 2 shows examples of PST entries from different weeks throughout the semester and the length of the project.

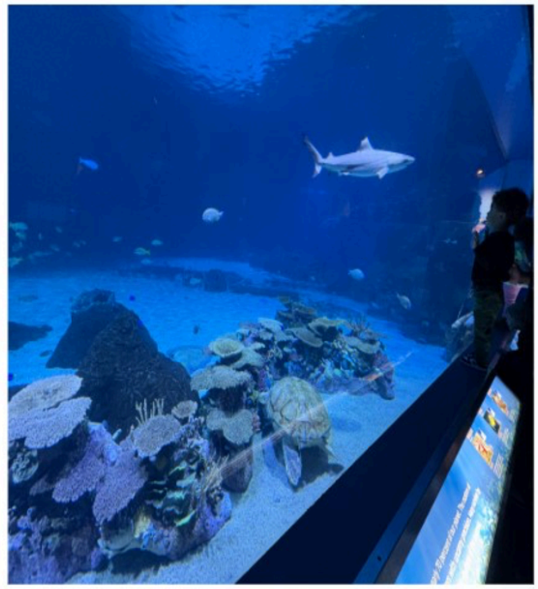
Figure 2

Some examples of the Science Around Me entries at different stages in the project with more questions, SEPs, and the inclusion of the CCC by the end

Science Around Me Entry #1

- How do different salt levels in the ocean affect the ability of marine organisms to survive?
- STEELS: 3.1.6-8.L
  - Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- SEP: Planning and Carrying out Investigations
  - Students can utilize aquatic plants in varying saltwater concentrations. Data collection can consist of recording survival rates of the plants.
- SEP: Constructing Explanations & Designing Solutions
  - Based on their results, students can describe how salt levels can impact marine life.

This is relevant to students and society because of the ocean covers nearly ¾ of the planet and controls climate and hosts a great amount of life. It stores oxygen and carbon dioxide. It is relevant to everything on Earth because of how climate change and pollution impacts the water, plants, and animals.



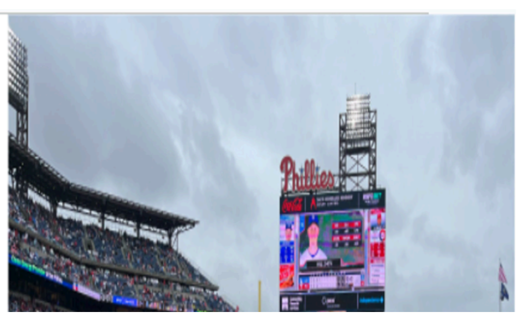
Science Around Me: Week 3

Scientific Questions: What types of items are attracted to a magnet? Does the size or shape of a magnet influence how much it can attract?
STEELS: 3.2.3.D Define a simple design problem that can be solved by applying scientific ideas about magnets.
SEP 1: Planning and Carrying Out Investigations
Get a whole bunch of different things to test if they are magnetic or not, and classify each item to try and determine if there are any similarities in what is or isn't magnetic.
SEP 2: Analyzing and Interpreting Data
Use different size and shape magnets, test them to see how far an object is before it is pulled toward the magnet, record these distances and calculate the average.
Relevance: Magnets are very relevant because we all use them in everyday life, on whiteboards, fridges, toys and games, speakers, and to clean up/collect things, and even medical instruments (like a MRI) use magnets. Magnets are used by people all around the world for all these things. We have to mine the iron to make the magnets, so that could affect the environment.

Science Around Me Week #8

Scientific questions:
How does crowd noise, flashing signs and lights, and fan movement influence a player's reaction time?
How much force is exerted on the ball during a pitch or a hit?
How does weather affect how far a baseball travels?
What differences can we measure between how a ball bounces and rolls on real grass, artificial turf, and sand?

SEPs
SEP: Analyzing and Interpreting Data: Gather reaction time stats from MLB or high school games comparing player performance in noisy situations vs. quiet ones in practice sessions.
SEP: Planning and Carrying Out Investigations: Set up an experiment:to roll and bounce a baseball on different surfaces to observe and record ball behavior and time travel.



SEP: Using Mathematics and Computational Thinking: Use scientific formulas like, Force = mass × acceleration to determine the relationship between bat speed and ball speed and ball distance..
SEP: Constructing Explanations and Designing Solutions: Research how these variables like air pressure, temperature, and humidity affect playing conditions.

STEELS:
3.1.4.B Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.
3.2.3.B Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

CCC
Cause and Effect
I see any of these investigations as cause and effect. The amount of force (cause) on the ball influences how far it travels (effect). The same with the weather. Different materials like sand, or grass or turf will have an effect on how a ball rolls or bounces. Lots of noise and distractions will affect a baseball player's reaction time when they play.

Relevance
Many sports that we play, like baseball or softball, rely on you having a quick reaction time, whether it's catching or throwing a bal or, reacting to a starter's gun. Many people enjoy watching and participating in all types of sports as it is a good and healthy way to exercise and it is igood to have a hobby and different interest. Sports are played by people all around the world. The types of materials people use to build stadiums, fields, and other things that are used to play the sport influence how an athlete plays or performs.

The example from Week 1 of the project (the aquarium) shows how the student included the cause-and-effect relationship of a variable (salt water) and its impact on living things. The Week 3 example is from an early grades PSTs using refrigerator magnets to develop questions (notice there are two questions now) that could initiate an investigation into this phenomenon commonly done at the elementary level. Late in the project, by Week 8, a middle grades entry at a Phillies baseball game is up to four questions covering various phenomena experienced at a stadium during a game. This entry also now explains how they would infuse the CCC into a potential investigation.

Short videos are also acceptable and have included many of the above-mentioned themes. The important thing for PSTs to remember is that these are pictures of their own lives and experiences, all of which can be relatable to their own students. Much of what I have seen since implementing this assignment is ordinary, everyday things that people – including their future students – have seen, experienced, or can experience and relate to.

Each week I reviewed the PST's entries to ensure their question writing skills and explanation for relevance met the target for mastery (I used mastery grading on all assignments) A sample rubric that outlines what mastery is for the individual entries is included in Supplemental Materials. Because the portfolio is an ongoing, almost semester-long assignment, students have the opportunity each week to go back and revise, amend, and correct their entries when there is a shortcoming noted. Through this continuous feedback cycle over the weeks of the project, I observed ample evidence of PSTs' growth and understanding.

Impact on Science Content and Pedagogy

Initially, generating a single question was a challenge to some PSTs when they were asked to ensure that it was scientific and could be investigated. There were several revealing issues, mainly the inclusion of the question, "What is this?" and "Where is this?" But through regular guidance and feedback, these types of questions, while appropriate in some contexts and content areas, are dropped and avoided as the semester progresses. Instead, more, if not all, PSTs at both the early and middle grade levels quickly started modeling their questions using the Cruz-Guzman taxonomy and Bloom's taxonomy. In addition to the examples in Figure 2, other random examples of higher gain questions include: How does the water temperature affect the amount of oxygen that is in the river? (middle grades PST), How does humidity affect the ice surface and friction when skating? (middle grades PST), How does the mass of the deer and the car influence the amount and type of damage caused? (middle grades PST), Do different metals rust faster than others? (early grades PST), How well does sunscreen block the Sun from burning our skin? (early grades PST).

Many PSTs, both the early grades and middle grades, came away with a better understanding of basic science and scientific principles and processes, because once they reflected and realized what the phenomenon(a) in the picture was, they themselves researched more about it in order to generate questions and what could be investigated. Each week, because the picture was usually different and unrelated to the previous week's entry, the PSTs explored that content further and widened and deepened their science content knowledge through the lens of asking questions. Although there are some content and phenomena that some PSTs, particularly the elementary-bound PSTs, identified and pursued with their line of questions and prospective investigations using the SEPs, some gaps in content knowledge may have started to fill in and could enhance their science teaching in the future due to this increased breadth and depth.

At the end of the semester, I asked my students for course takeaways in their reflection logs, which included any thoughts on the portfolio "process" of questioning and relevance. Some of the comments from both the early and middle grades PSTs ranged from getting to know content better, emphasizing relevance, and other pedagogical (science and general teaching) strategies. Overall, there was a plurality of positive comments. It is of note that the comments were made in their logs, and I could see who made what comment, so there may have been some comments that I favored. Discussing science content, one PST wrote that, "It helped to get to know the material and concepts inside and out." Another described "Asking good questions is important to help our students' inquiry along and drive critical thinking. When we give them space to think about difficult questions, they can develop their own answers using other SEPs." Others focused on student learning. One PST suggested, “Putting ourselves in the students’ shoes [allowed me] to discover ways to make it [science] more entertaining.” Another wrote simply that, “I thought more about how students actually learn.” A third expressed, “I want to develop strong open-ended questions that will encourage students to explain their thinking and use evidence.”

Other PSTs honed in on the importance of relevance. One discussed how “Designing lessons that have… real-world connections with the content helps students see the relevance of what they are learning.” Similarly, another wrote that, “When we help students see science in their everyday lives, we make the learning more relatable and make the lessons more memorable and meaningful.” A third described how, “Making connections to real-world scenarios will help students understand the importance of the science they are learning and why it matters. A lesson based on everyday experience is more inclusive, accessible, and meaningful to every learner.” One PST encompassed these other responses, expressing, “Making the science relevant to students’ lives is crucial in the engagement of the subject.”

Middle grades PSTs noted in both their field logs and informally in conversation in class each week in reporting back about their field classes, how they observed their mentor use of questioning, and reinforcing the relevance of the content to the students, and the use of the SEPs throughout the lessons. This reinforced the intent of the Science Around Me components, which they ensured they included when they got to teach and co-teach a lesson in their field class. Students generally appreciated using their own resources. Suddenly looking at a record of their own lives from a different perspective – one to be used as a springboard for learning and learning science.

Implications and Moving Forward

The endeavor of developing and delivering the Science Around Me electronic portfolio has been shown to be an effective tool in prompting PSTs to develop scientific questions that have the potential to generate sensemaking investigations with guidance from the SEPs and CCCs. It also appears to expand and deepen PSTs’ scientific content knowledge by using visual imagery from their own personal experiences and viewing it from a new and different perspective. The portfolio also progresses PSTs’ ability to make sense of the phenomena in their visual images and their ability to explain the relevance of those phenomena at different levels (individual, societal, planetary systems) and in terms of consequence, per Stuckey et al. (2013). This may assist in PSTs making their science lessons more student-centered and inquiry-based and approach teaching science with a more positive affect, per Yesilyurt (2022). This authentic, practical experience of taking a typical encounter with various aspects of our daily life and examining and explaining it in a scientific manner is a skill and task I will continue to keep as part of the repertoire for my science teaching methods classes. I foresee formally researching the classification of PSTs’ questions in terms of content and level (as per Cruz-Guzman et al., 2018) and the PSTs’ ability to explain relevance at different levels.

I strongly recommend this activity for PSTs because it can help them to reflect on and develop improved recognition of how science (and engineering and technology) impact their own lives and how they must be able to relay this to their future students. It is essential that PSTs make these connections (Gunning & Mensah, 2011), including to their own identities (Aavramidou, 2016), which can then be leveraged to provide meaningful and inclusive science experiences to their future students. If we intend PSTs to take up science when often only provided with minimal instructional time (Banilower et al., 2018), they need personal connections, self-efficacy, and the questioning tools needed to forge and maintain students’ science interests. This assignment has been a positive growth experience for the PSTs and for me as well, revising and expanding my practice in teaching science methods classes, and promoting that intentional step back to notice and wonder, and appreciating the science around me and that is around all of us.

Supplemental Files

ASTEInnovations-Science-Around-Me-Rubric-for-Mastery.doc
ASTEInnovations-Science-Around-Me-weekly-tasks.ppt

References

Antink-Meyer, A., Brown, M., & Wolfe, A. (2023). The Scientific Curiosity of Preservice Elementary Teachers and Confidence for Teaching Specific Science Topics. *Journal of Science Teacher Education*, *34*(8), 883-902.

Avraamidou, L. (2016). Studying science teacher identity. In *Studying Science Teacher Identity* (pp. 1-14). SensePublishers.

Banilower, E. R., Smith, P. S., Malzahn, K. A., Plumley, C. L., Gordon, E. M., & Hayes, M. L. (2018). Report of the 2018 NSSME+. *Horizon Research, Inc.*Bjerknes, A. L., Wilhelmsen, T., & Foyn-Bruun, E. (2024). A systematic review of curiosity and wonder in natural science and early childhood education research. *Journal of Research in Childhood Education*, *38*(1), 50-65.

Brownell, S. E., Price, J. V., & Steinman, L. (2013). Science communication to the general public: why we need to teach undergraduate and graduate students this skill as part of their formal scientific training. *Journal of Undergraduate Neuroscience Education*, *12*(1), E6.

Bruner, J. S. (1997). The culture of education. In *The culture of education*. Harvard University press.

Cruz-Guzmán, M., García-Carmona, A., & Criado, A. M. (2017). An analysis of the questions proposed by elementary pre-service teachers when designing experimental activities as inquiry. *International Journal of Science Education*, *39*(13), 1755-1774.

Cruz-Guzmán, M., García-Carmona, A., & Criado, A. M. (2020). Proposing questions for scientific inquiry and the selection of science content in initial elementary education teacher training. *Research in Science Education*, *50*, 1689-1711.

Dewey, J. (1986). Experience and education. In *The Educational Forum*, vol. 50, no. 3, pp. 241-252. Taylor&Francis Group, 1986.

Gunning, A. M., & Mensah, F. M. (2011). Preservice elementary teachers’ development of self-efficacy and confidence to teach science: A case study. *Journal of Science Teacher Education*, *22*, 171-185.

Guo, D., McTigue, E. M., Matthews, S. D., & Zimmer, W. (2020). The impact of visual displays on learning across the disciplines: A systematic review. *Educational Psychology Review*, *32*(3), 627-656.
Kinskey, M., & Zeidler, D. (2024). Elementary preservice teachers' pedagogical decisions about socioscientific issues instruction. *Journal of Research in Science Teaching*, *61*(8), 1890-1924.
Loughran, J. J. (2013). Science teacher as learner. In *Handbook of research on science education* (pp. 1043-1065). Routledge.
McDonald, M., Kazemi, E., Kelley-Petersen, M., Mikolasy, K., Thompson, J., Valencia, S. W., & Windschitl, M. (2014). Practice Makes Practice: Learning to Teach in Teacher Education. *Peabody Journal of Education*, *89*(4), 500–515. https://doi.org/10.1080/0161956X.2014.938997
Muimongkol, S. C., Subramaniam, K., & Wickstrom, C. D. (2022). Dimensions and orientations of pre-service early childhood teachers' conceptions of teaching science. *Early Childhood Education Journal*, *50*(1), 145-156.
National Research Council (NRC). 2011. *Successful K–12 STEM education: Identifying effective approaches in science, technology, engineering, and mathematics*. Washington, DC: National Academy Press.
National Science Teachers Association. (2018). *NSTA Position Statement: Elementary science education.* https://static.nsta.org/pdfs/positionstatement_elementary.pdf
NGSS Lead States. (2013). *Next generation science standards: For states, by states*. National Academies Press.
NSTA. (2020) STEM Education Teaching and Learning. Retrieved from https://www.nsta.org/nstas-official-positions/stem-education-teaching-and-learning
Palmer, D. H. (2006). Sources of self-efficacy in a science methods course for primary teacher education students. *Research in science education*, *36*(4), 337-353.
Radloff, J. (2018). *Exploring the Role of Reflexivity in Supporting Preservice Elementary Teachers' Conceptions of Science as Socially and Culturally Embedded* (Doctoral dissertation, Purdue University).
Rosenfeld, J. A. (2003). Rosalind Franklin: The Dark Lady of DNA. *BMJ*, *326*(7383), 289.
Smith, P.S., Goforth, C.L., Carrier, S.J., Hayes, M.L., and Safley, S.E. (2025). 'An Emerging Theory of School-Based Participatory Science', *Citizen Science: Theory and Practice*, 10(1), p. 1.
Stuckey, M., Hofstein, A., Mamlok-Naaman, R., & Eilks, I. (2013). The meaning of 'relevance'in science education and its implications for the science curriculum. *Studies in science education*, *49*(1), 1-34.
Vale RD. The value of asking questions. Mol Biol Cell. 2013 Mar;24(6):680-2. doi: 10.1091/mbc.E12-09-0660. PMID: 23486404; PMCID: PMC3596240.
Windschitl, M. (2003). Inquiry projects in science teacher education: What can investigative experiences reveal about teacher thinking and eventual classroom practice?. *Science education*, *87*(1), 112-143.
Yasin, R., & Parisu, C. Z. L. (2025). Visual Media as a Driver of Interest in Learning Natural Science In Elementary Schools. *International Journal of Management and Education in Human Development*, *5*(01), 1553-1557.Yesilyurt, E. (2022). Investigating Elementary Preservice Teachers' Beliefs About Teaching and Learning Science. *Journal of College Science Teaching*, *51*(5), 23-30.