

Section

5 Appendix A3

Other supporting documentation:

Notes/papers summarizing process and progress

Selected email communications documenting process and progress

Interview with TBA

The intent of our project is to develop a set of items that will assess the conceptual knowledge of teacher candidates in the science content that they will teach at the elementary level. According to the INTASC Standards, teachers should “understand the central concepts, tools of inquiry, and structures of the discipline” they teach and they should be able to “create learning experiences that make these aspects of subject matter meaningful for students.”

We believe that science is a way of knowing about our universe, nature, and the interrelationships between and among certain fundamental processes and concepts. Harlen (1993) has identified six fundamental areas of knowledge for teaching elementary science: (1) characteristics of living things; (2) processes of life; (3) materials, their properties and interactions; (4) energy sources, transmission and transfer; (5) forces and movements; and, (6) the earth and its place in the universe.

Because of the nature of the scientific discipline, we believe that it is critical that elementary teachers be familiar with the tools to acquire new and deeper understandings of the scientific content they may be asked to teach. To teach science as a way of knowing, we believe that teacher candidates should be able to model what scientists do and how scientists think. Therefore, the assessment items we design will require teacher candidates to draw upon one or more of the following aspects of scientific inquiry that we have identified as necessary for teaching elementary science: (1) observing objects and events in sequence and finding patterns and relationships between and among observed phenomena; (2) raising questions; (3) hypothesizing and predicting; and, (4) using the process and tools of inquiry, including designing and conducting scientific investigations, making models, and analyzing data (Adapted from Harlen, 1992).

Science

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Areas of science knowledge for elementary teachers:

Strands: 1 & 2: Life Sciences (Characteristics of living things; life cycles of organisms; organisms and the environments)

Concepts/Content: Human body; ecosystems; food chain

Strand: 3 Materials, properties and interactions

Concepts/Content: Properties of objects and materials; position and motion of objects

Strand 4: Energy Sources, properties and interactions

Content/Concepts: Light, heat, electricity, magnetism

Strand 5: Forces and movements

Content/Concepts: Simple machines; gravity

Strand 6: Earth and its place in the universe

Content/Concepts: Properties of earth materials (fossils); objects in the sky (earth, planets, stars); changes in earth & sky

Conceptual Understanding (Deep Principles of the Discipline): Understanding of scientific ideas as measured by responses that draw upon the deep principles of the discipline to explain scientific concepts

(Based upon *NSES Unifying Concepts and Processes; Model Standards in Science for Beginning Teacher Licensing and Development (INTASC)*)

- 1) Understand that the behavior of the universe is not capricious, that nature is the same everywhere, and that it is understandable and predictable
 - a) Objective: Explain units of investigation as systems or organized groups of related objects or components that form a whole
- 2) Provide sophisticated explanations of scientific concepts
 - a) Use evidence of logic and analysis when providing explanations
 - b) Use models as explanations of how things work
- 3) Understand that interactions within and among systems result in change and understand how changes vary in rate, scale, and pattern
 - a) Explain how interactions within and among systems result in change and quantify the changes, where appropriate
- 4) Understand evolution as a series of changes that account for the present form and function of objects, organisms, and systems; understand equilibrium as a physical state in which changes off set each other to achieve balance
 - a) Provide explanations that account for the present form and function of objects
- 5) Understand how form and function are complementary aspects of objects
 - a) Explain form by referring to function and function by referring to form

Scientific Inquiry

- A) observe objects and events in sequence, find patterns and relationships between and among observed phenomena, and draw a logical conclusion
- B) raise questions that can be investigated
- C) hypothesize and predict
- D) use the process and tools of inquiry (i.e., design scientific investigations and analyze data)

UNH MATH GRANT

The goal of our project is to develop and pilot a set of assessment items to measure our elementary teacher candidates' mathematics content knowledge.

Teachers of mathematics should understand mathematics and how students learn mathematics and provide learning opportunities that support their intellectual, social, and personal development. Looking at NCATE's Standard 1 reinforces the importance of our focus by requiring that teacher candidates know their content, can teach, and can help all students learn. The questions we pose are, "What should our teacher candidates know and be able to do in an elementary mathematics class?" and "How will we know what our teacher candidates know and can do what they ought to know when they leave our program to be successful elementary math educators?"

In order to approach the problem of designing our assessment tasks in mathematics we decided we needed to have a clear view of the kinds of understandings and skills that we wish to assess in our teacher candidates, and the ways in which the tasks we design elicit demonstrable evidence of those skills and understandings. Rather than focus on specific content strands we thought it would be better to design our assessment on a wide range of traditionally taught mathematical concepts/skills that would require our candidates to reason mathematically, see patterns, and problem solve. The first part of our assessment will focus on the basic understanding of teaching and knowing the math on an elementary level. The second part will involve open-ended tasks that will require our teacher candidates to ponder and reflect on a variety of rich problems to determine a solution. Included in our tasks will be content-specific pedagogy to determine if the candidates can recognize errors in their students' work and some of the underlying misconceptions and are able to suggest ways to help the student correct these concepts. Effective teaching requires knowing and understanding mathematics, students as learners, and pedagogical strategies.

INTASC

Standard 1, Subject Matter.

The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and can create learning experiences that make these aspects of subject matter meaningful for students.

1.12

The teacher understands how students' conceptual frameworks and their misconceptions for an area of knowledge can influence their learning

Standard 2, Student Learning.

The teacher understands how children and youth learn and develop, and can provide learning opportunities that support their intellectual, social and personal development.

2.11

The teacher understands how learning occurs--how students construct knowledge, acquire skills, and develop habits of mind--and knows how to use instructional strategies that promote student learning

Standard 4, Instructional Strategies.

The teacher understands and uses a variety of instructional strategies to encourage students' development of critical thinking, problem solving, and performance skills.

UNH Title II: Practicing What We Teach: Using Assessment to Inform Instruction

Project goals and relationship to long range plans

1. Goal: Develop a set of assessment items that will evaluate the conceptual knowledge base of incoming elementary education candidates. These items should represent the basic content knowledge necessary for teaching science and math at the elementary level.
Plan: Results of the assessment and the content strands identified will be used to: (1) provide candidates with information about their strengths and weaknesses upon entering the program and (2) develop undergraduate courses in science and mathematics expressly designed for elementary education candidates who need to strengthen their content knowledge in these two critical areas.
2. Goal: Strengthen our capacity by building alliances among A&S faculty, practicing teachers, and part and full-time education faculty. For example, strategy course instructors participate in the development and scoring of items.
Plan: A&S faculty and practicing teachers will participate in the development of the undergraduate courses.
3. Goal: Select from the item pool a set of post test items that may be used to assess candidates' knowledge at the completion of their coursework.
Plan: Candidates will be provided opportunities for strengthening their content knowledge throughout their program (e.g., taking one of the newly developed courses or acquiring content knowledge through research as they develop units and lesson plans in strategies courses). These post tests will assess whether or not candidates have acquired the basic content knowledge deemed necessary for teaching science and math at the elementary level.
4. Plan: Investigate the hypothesis that students may acquire content through strategies courses as they participate in the kinds of learning experiences we offer as models as we encourage them to design similar learning experiences for their own students.

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