

Elementary Mathematics Performance-Based Assessment

Initial/Professional Teacher Education
University of Colorado at Denver

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Resources:

Colorado Model Content Standards

National Council of Teachers of Mathematics *Principles and Standards*

What is the purpose and importance of mathematics education in the elementary classroom?

For ages, cultures and societies have recognized the importance of mathematics. Mathematics is a language that helps us describe ideas and relationships drawn from our environment. As the science of patterns, mathematics enables us to make the invisible visible and thereby solve problems that would otherwise be impossible. Mathematics is a tool of science and technology, not only through computational aids, but by enabling scientists to explore concepts with idealized models before trying them in the real world. Children in elementary school are capable of engaging mathematics in all its aspects, and, if they are to grow intellectually, they must.

Today mathematics encompasses much more than basic arithmetic. In addition to basic numeracy, mathematics includes measurement and geometry, functions and algebra, data analysis, and probability. In order for you to become skilled at teaching mathematics, in ways that may be different from how you were taught, you need to encounter the range of mathematics in meaningful contexts yourself, and you need to learn how to balance skill acquisition with conceptual development in your students as you develop their problem solving power.

When the mathematics curriculum is rich in problem solving and inquiry, students acquire knowledge and habits of mind that support learning across the curriculum. If a student is a better learner and problem solver after spending a year under your tutelage, you have increased his or her chances of success in school and beyond. You have made a difference.

What do I need to do?

First you must **pass Math 3040**. Details of course requirements are in the syllabus and schedule. In addition to performance-based exams, the course requires work with students in partner schools and an interview project in which you interview four or more students individually to probe their understanding of a particular mathematics concept.

Second, you must **pass IPTE 5002**. This involves mastery of course content and work with students in partner schools, including the Instructional Project described below. IPTE 5002 is normally taken during the second, third and fourth internships. IPTE 5002 meets in regular class format for the first half of the semester with a final session (or two) after your fourth internship.

The following steps detail the **Instructional Project** part of the PBA.

- a) Gather information about the students' mathematical strengths and needs, and make an instructional plan to support student growth. Refer to the textbook and materials in IPTE 5002. Your plan must describe
 - a) Objectives for student learning,
 - b) Activities to help students learn, and
 - c) Assessment to evaluate how well the students learned.
- b) Provide small group (or whole class) math instruction in the specific mathematics content, employing methods supported by what you are learning in MATH 3040 and IPTE 5002. You should ask your clinical teachers, site coordinator and/or professor to coach your lessons.
- c) Write a description and analysis of your teaching, including a section devoted to what is revealed on the videotape. The description should include your analysis of why you think it turned out the way it did, what worked and what that means, and what you learned about teaching.

NOTE: 1) The particulars of your instructional project depend very much on your situation in your internship. In most cases the instruction will be over several days, and completed during your full-time internship. How you complete this requirement should be negotiated with your instructor and clinical teacher. The essential requirements are that you explore the mathematical understanding of several students, plan instruction for them, and analyze how well you accomplished your goals for their learning.

2) The format for presenting your work on the Instructional Project is in the syllabus for IPTE 5002.

How will others help me?

Clinical teachers, site coordinators, and leadership area professors will support you to learn and meet the standards inherent in this PBA as follows:

- Co-teaching with the TC during internships
- Providing math content tutorials when necessary
- Review State and District mathematics standards with the TCs
- Providing TCs with mathematics pedagogical information and skills through course work in M3040 and IPTE 5002.
- Guiding TCs in understanding assessment techniques and evaluation of student work.
- Critiquing the TCs instructional plan
- Observing the TC instruct a small group of students

How will my performance be evaluated and scored?

See the rubric on the next pages. You will see that when you receive acceptable grades (at least B-) in Math 3040 and IPTE 5002, you will have completed the Elementary Math PBA.

Performance	Basic	Developing	Proficient
Complete M3040	Has not enrolled	Enrolled and working hard	Earned grade of B- or higher
Interview Project (Partial fulfillment of M3040)	TC is not sure about what questions to ask. TC has little sense of the mathematics implied in the standards being explored. TC asks irrelevant questions. The teacher candidate's analysis of the subjects' understanding is based on personal impressions more than insightful probing. Questions and analysis suggest TC does not understand the mathematics very well. TC has no references to course materials as sources of ideas, did little research into appropriate tasks and questions. When interviewing students TC displays little flexibility and few insights into the students' thinking, does little probing of their responses. Written work suggests failure to use a spell checker.	TC has compiled several appropriate questions. TC can suggest one or two mathematical interpretations of the standards being probed. TC has chosen some activities that allow an insightful probe of students' understanding of the mathematics implied by the standard. TC uses adequate wait time when questioning students in interviews and follows guidelines for successful interviews presented in the Van de Walle methods text. TC's work reveals a few gaps in his or her understanding of the relevant mathematics. Write-up needs to be more clear and easier to read.	Interview task clearly embodies the mathematics in the standard being explored. Focus is on conceptual understanding, rather than procedural fluency. TC skillfully builds probe upon student responses. Interview emphasizes the probe for how students think, with little if any direct instruction during the interview. Adequate wait time. Good use of questions such as "Tell me what you are thinking." "Why do you think it is that way?" "Tell me more about..." TC can explain how students' responses reveal their level of understanding. TC's work reveals sound understanding of the relevant mathematics. Interviews reveal skill in probing for understanding and building on student responses. Write up is well organized, thorough and clearly written. Interviews are on videotape showing TC in action.
Complete IPTE5002	Has not enrolled	Enrolled and working hard	Earned grade of B- or higher in course work, including the completion of an Instructional Project at the Proficient level.

Performance	Basic	Developing	Proficient
<p>Instructional Project (Partial fulfillment of IPTE 5002)</p>	<p>TC is tentative when implementing instructional elements, even with a prepared curriculum. TC depends totally upon "telling" and having students do seatwork with paper-and-pencil worksheets. TC does not reveal knowledge of more than one approach to the learning outcomes. TC does not try to help students see how their work relates to other work and important ideas in mathematics (e.g. patterns). Students do not understand instructions given by TC. TC gives directions before having attention of all students. Lessons deviate from plans for no justifiable reason. Lessons do not employ basic pedagogical principles presented in IPTE 5002, especially those that help students make sense of mathematics. TC is unaware of individual differences in understanding. TC does not encourage mathematical discourse among students. TC uses sarcasm and threats to control student behavior. TC displays negative attitude toward teaching mathematics.</p>	<p>TC is fairly comfortable with prepared curriculum and can make a few modifications for particular students. TC goes beyond having students do seatwork with paper-and-pencil worksheets, but still dominates discussions. TC is aware of several approaches to the learning outcomes. TC tries to help students see how their work relates to important ideas in mathematics. TC is getting better at giving clear directions to students. TC 's questioning skill is improving--better use of wait time, more open ended questions. TC is getting better at building upon student responses and behaviors to individualize instruction. Instructional choices reveal understanding of mathematics. Lessons employ some of the basic pedagogical principles presented in IPTE 5002. TC makes effort to encourage mathematical discourse among students, but needs more practice. TC is beginning to take responsibility for improving own pedagogical skills, seldom blames students.</p>	<p>TC can make principled pedagogical choices and build upon, or deviate entirely from, the prepared curriculum. TC can make effective modifications for particular students. TC knows when it is appropriate for students to do seatwork with paper-and-pencil worksheets. TC is aware of several approaches to learning goals and balances conceptual understanding and skill mastery. TC can give clear directions to students. TC's questioning is effective--good use of wait time and many open-ended questions. Instructional choices reveal understanding of mathematics and that mathematics is the science of patterns. TC frequently helps students see connections among the concepts and procedures they are learning. Lessons employ many of the basic pedagogical principles presented in IPTE 5002 and modeled in Math 3040. TC is skilled in sustaining mathematical discourse among students and teaching through problem solving. TC can explain how choices fit in with major goals of instruction. Each student's work reveals increases in conceptual understanding and progress toward mastery of skills. TC chooses activities that engage students (evidence of this is when students want to complete the tasks without prodding by the teacher). Analysis of the implementation of the instructional unit and videotaped lesson(s) are rich in details, well written and reveal a grasp of pedagogy. Videotape of TC in action shows that many of the above criteria met.</p>

Mathematics Instructional Project Evaluation

This evaluation is to be completed collaboratively by the Teacher Candidate's Clinical Teacher (CT), Site Coordinator (SC) and Site Professor (SP). Input from each will vary depending upon the opportunities for observation of, and collaboration with, the TC. The checklist will weigh heavily in determining the final evaluation of the TC by the IPTE 5002 instructor.

We have tried to make the criteria as specific and clear as we can, but it is impossible to describe good teaching behaviors completely. We depend upon the trained eye and judgement of the evaluators. When a criterion is not sufficiently clear to the evaluator, check with the TC's methods textbook and course materials.

For each criterion give a score of 1-10, with a 10 meaning the TC is one of the best *novices* you have ever seen at the performances described. A 5 means the TC is fairly strong, and you anticipate improvement with more experience. A 1 means the TC has made no progress and you doubt he or she will get better with experience. Enter an "N" when you haven't been able to gather enough data to make a judgement. Remarks should be anything you want to say to support your rating.

Performance	Rating			Remarks
	CT	SC	SP	
1. TC can make thoughtful pedagogical choices and build upon, or deviate entirely from, the prepared curriculum.				
2. TC can plan individualized curriculum when necessary to meet particular student needs.				
3. TC uses individual paper-and-pencil, drill-and-practice seatwork at most half the time and makes sure students understand the material before working independently.				
4. TC continually strives to help students develop prowess with mental math.				
5. TC attends as much to conceptual understanding as to skill mastery.				
6. TC can give clear directions and explanations to students. Explanations reveal sound understanding of the relevant mathematics.				
7. TC questions skillfully--good use of wait time and many open-ended questions. (Tell me what you're thinking about ...? Explain to us how you got that. How is ... like....? How				

	Rating			
are they different?				
8. TC is skillful in sustaining mathematical discourse among students, both among students and between teacher and student. (Kyle, could you explain to Maria how you got 16?)				

Performance	Rating			Remarks
	CT	SC	SP	
10. TC frequently helps students see connections among concepts and between the concepts and procedures they are learning.				
11. TC teaches lessons that display many of the basic pedagogical principles and strategies presented in IPTE 5002 and modeled in Math 3040.				
12. TC makes appropriate use of calculators and computers to engage students in explorations as well as skill practice.				
13. TC chooses activities that engage students (evidence of this is when students want to complete the tasks without prodding by the teacher).				
14. TC teaches through problem solving, encouraging students to grapple with ideas rather than blindly follow the teacher's direction. (TC respects the struggle associated with genuine learning.)				
15. TC uses varied and authentic assessment tasks (written, oral, projects, performances, etc.), both formally and informally, to make pedagogical decisions and increase learning.				
16. TC's classroom is not dominated by teacher talk. Students are expected to be active participants and contributors to a culture conducive to doing math.				

Partner School _____

Grade Level _____

Signatures

CT _____

SC _____

SP _____ Date of Evaluation _____