

Three-Tiered Assessment Plan

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Morrison, Ross, Kalman, and Kemp (2013) state, “evaluating learning is essential in the instructional design process... you must develop the testing instruments and materials to measure the degree to which learners have acquired the knowledge, can perform the skills, and exhibit changes in attitudes as required by the objectives” (p. 252). This three-tiered assessment plan will incorporate formative, summative, and confirmative evaluations.

Formative Evaluations

Determining the needs of the target audience:

As a certified teacher for Mathematics: Grades 5 – 9, my in-classroom experience is mostly with middle school students. Currently I tutor students in math whose ages range from middle school to mid-thirties. When I begin working with my students to determine where their *basic* struggle or confusion begins, it is usually with one (or all) of these topics: integer operations, order of operations, converting between fractions, decimals and percents, and word problems. In fact, according to Rubin, Marcelino, Mortels, and Lapinid (2014), “Many students enter high school level with severe gaps in their concepts and skills in mathematics. One of these basic foundational knowledge and skills is the integers, a necessary prerequisite skill to solve equations” (p. 1).

In their research brief posted on the National Council of Teachers of Mathematics website, Cai and Lester (2010) state, “Developing students’ abilities to solve problems is not only a fundamental part of mathematics learning across content areas but also an integral part of mathematics learning across grade levels” (p. 4). Establishing a strong foundation in understanding and properly applying the order of operations benefits students as they progress in mathematics and helps develop students’ problem-solving abilities. Both the “Tell’em in 10”

active strategies presentation and the Versal course specifically addressed building that foundational understanding of the order of operations.

Formative assessments used in Order of Operations “Tell’em in 10” and Versal course:

Each of the formative assessments build upon each other. Establishing proficiency at each level (i.e. a strong foundation) is the desired goal in order for the student to understand and apply the order of operations concepts.

- “What’s in a Name” categories activity: The students would determine which terms belong with PEMDAS and which ones don’t. Demonstrating knowledge of those terms is necessary for using the PEMDAS mnemonic to assist in determining the proper order of operations.
- “You Tell Me” student-led instruction activity: After the instructor-led demonstration of the order of operations for the 2 problems introduced in the PEMDAS Rap video, the student(s) would have the opportunity to provide the step-by-step process for solving a third problem using the order of operations. This activity would show their level of understanding the order of operations concepts to the teacher, as well as to the students themselves.
- “You Show Me” sequencing activity: The students are presented with a problem and the steps required to solve that problem. The students would then order those steps in the proper sequence demonstrating their understanding of the order of operations.
- Quizlet matching activity: Up to twelve problems and their solutions are displayed. The students must evaluate each problem in order to determine its solution. Once solved, the students would then match the problem to its appropriate answer. This activity demonstrates the individual students’ understanding of the full process of using the order

of operations. Since the matching game is part of a Quizlet, the quiz option could also be used as part of a reassessment, if needed.

- “If you could ask one last question” discussion activity: The students are given the opportunity to post “one last question” to a discussion board. Based on the students’ questions, the teacher can determine the applied level of the students’ understanding of the order of operations concepts.

Mechanisms for remediation (if needed):

If students are not understanding or applying the order of operations concepts properly then the following strategies will be used for remediation:

- Tutoring context: If the student is not understanding certain concepts, then those problem area(s) will be retaught, practiced, and reassessed with formative evaluations / activities.
- Classroom context: If the majority of students are not understanding certain concepts then the problem area(s) will be retaught to the entire class, practiced, and reassessed with formative evaluations.
- Classroom context: If a few students are not understanding certain concepts then I would reteach the concepts to that group and/or would pair students who have a strong understanding of the order of operations to work with students who don’t and have peer-to-peer instruction/interaction. Following either of those activities, the students would be reassessed. This could be a somewhat iterative process until the students have a functional understanding of the order of operations.

How the collected data will be used:

The data collected will be used to determine the level of understanding the students demonstrate. For students whose formative assessment scores are 75% or below, then the strategies described in the remediation section above will be employed.

Summative Evaluation(s)

1. *Specifying program objectives*

The following table identifies the learning objectives associated with the order of operations:

Objectives	Domain	Level	Content Structure	Performance
Topic: Order of Operations				
2.0 Given any combination of numbers and operations, the learner will accurately apply the order of operations to evaluate expressions.	Cognitive	Evaluating	Rules / Procedures	Application
2.1 The learner will display a willingness to learn the procedures associated with the order of operations.	Affective	Receiving / Responding	Attitude	Application
2.2 The learner will accurately explain PEMDAS.	Cognitive	Understanding	Fact	Recall
2.3 The learner will examine at least ten problems involving order of operations and will apply the appropriate procedures to solve them.	Cognitive	Analyzing	Procedures	Application

2. *Determining the evaluation design for each objective*

- a. Cognitive domain objectives: A pretest and posttest will be given to the students to determine their knowledge and understanding associated with the order of operations.

- b. Affective domain objective: A pre-survey and post-survey will be given to the students to obtain personal opinions regarding their attitudes / beliefs about their abilities and readiness to learn.

3. *Developing data collection instruments and procedures for each objective*

- a. Questionnaires / surveys will be used to determine attitudes, beliefs, and readiness to learn associated with the affective domain. These surveys will include five-point rating scales such as

Low		Average		High
1	2	3	4	5

(Morrison, et al., 2013, p. 308).

- b. Achievement tests will be used to assess knowledge and understanding associated with the cognitive domain. These tests will include objective test items such as multiple choice and matching, as well as problem-solving questions, similar to the formative assessments listed above. The following guidelines will be incorporated with the problem-solving questions:

- i. Students should show their work in addition to the final answer.
- ii. Partial credit will be awarded when students use the correct procedures when the final answer is incorrect.

(Morrison, et al., 2013, p. 292).

4. *Carrying out the evaluation*

- a. Scheduling the data collection: In the classroom context, the pretests and posttests will be administered during a normally scheduled class period. In the tutoring context, the pretests and posttests will be administered during one-hour tutoring sessions.

- b. Collecting the data: The tests will be gathered during the given class period or tutoring session and will be scored within 24 hours.

5. *Analyzing the results from each instrument*

- a. The achievement tests will be graded to determine the students' raw scores. Analytics, either manual or software-based, will be used to determine if there are specific problem areas related to order of operations concepts or specific questions that may have been confusing. Bar charts and histograms will be used to display the resulting data. Comparisons between each student's pretests and posttests will also be shown in bar graphs.
- b. The pre-survey and post-survey results will be scored and compared to determine if the students' self-assessments regarding attitude, beliefs, and abilities improved and/or how those results changed. Comparisons between each student's pre-surveys and post-surveys will be shown in a bar graph.

6. *Interpreting the results*

Based on the results of the achievement tests and the surveys, improvements and tendencies can be determined and interpreted based on the graphical representation(s) of the data. Based on those results, follow-up instruction and/or follow-up interviews may be deemed necessary to meet the learning outcomes described in the learning objectives.

7. *Disseminating the results and conclusions*

- a. Group meetings: In a middle school context, grade-level-subject-matter teacher teams (e.g. 6th grade math teachers) meet to plan lessons and discuss assessment results. The team-lead inputs the results into a report that is given to one of the vice principals.

Depending on the results, reteaching portions of the concepts may be necessary, or specific students may receive one-on-one supplemental instruction.

- b. Individual discussions: In a tutoring or classroom context, feedback regarding the results will be given to each student and/or parent. Individual discussions may also involve ESE teachers.

Confirmative Evaluation(s)

Learner-oriented:

“Concerns the degree to which, as time passes, consumers of the instruction retain the skills and knowledge needed to perform at desired levels” (Morrison, et al., 2013, p. 337). In the tutoring context, as my students continue to move through their mathematical units, semesters, and grade levels, I am able to observe and assess their retention of the order of operations concepts. Beginning in middle school, order of operations is used throughout mathematics, and is a basic and unchanging set of procedures that are used to evaluate expressions and solve problems. It is included in the Grade 6 common core standard 6.EE.1. I use an adaptive learning software program called IXL for formative and confirmative assessments. The students enjoy using it since it is both fun and challenging, provides many opportunities for them to demonstrate their understanding of math concepts, and presents immediate feedback. Worksheets and achievement tests are other ways in which I assess my students’ retention of the order of operations procedures.

In the classroom / middle school context, since I may not have to opportunity to have the same students from year-to-year, observing my students is not a viable option regarding confirmative evaluations. However, if students remain in the same middle school, then

discussions with their current teachers regarding their retention of specific math concepts is possible; however, it is not probable, given the responsibilities teachers already have. As mentioned in the textbook, “Traditionally, the general, long-term benefits of educational programs are measured through statewide and national standardized tests given to students in public schools....” (Morrison, et al., 2013, p. 338). Comparing scores year-to-year could provide some indication of the students’ retention of the order of operations concepts.

Context-oriented:

“Concerns the degree to which the instructional product remains effective as conditions change over time” (Morrison, et al., 2013, p. 337). While the necessity for students to understand and apply the order of operations procedures throughout their mathematical endeavors from middle school through college will not change, the ways in which those concepts are taught and assessed may. Instructional approaches and technology, especially with regards to apps / software programs seem to evolve rapidly. It is mandatory that as a teacher and instructional designer I stay informed on trends in education. As such, both the delivery and assessment methods may need to incorporate these new strategies or technological enhancements in order to meet the needs of my students long-term.

References

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