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Assessment Project

Context of the Assessment

Grade: 9th Grade

Subject of assessment: Math

Specific topic/focus of assessment: Polynomials

Objectives

1. Students will solve polynomials by factoring when given a test, with 90% accuracy.

2. When given a test, students will add, subtract, and multiply polynomials, with 90% accuracy.

3. When given a test, students will divide two polynomials using long division by showing their work, with 90% accuracy.

Reflection

My objectives did accurately address what I wanted to cover because they all describe observable and measurable behaviors. I have always had a love for math, so as a future math teacher, I wanted to practice writing objectives and an assessment for a subject that I love and will eventually be teaching someday. Even more specifically, factoring is my favorite math concept, so I wanted to incorporate that into my objectives. Also, my objectives all clearly have a behavior, condition, and criteria which demonstrates that they cover what it is that I wanted to write my assessment on. Using the objectives, it was easier to write my assessment. From the objectives it seemed fairly simple to create the table of specifications. My three different objectives each have their own "task" associated with them. Because of this, I used Bloom's Taxonomy to place the questions in what I believe to be the correct place in my table. This task was overall, fairly simple. It was easier to write my test questions using my objectives because I knew exactly what it was that I was trying to get my students to do. Because of this, I knew the exact type of problem that I would have them answer. From there, I was able to write the questions fairly quickly, and just had to decide which numbers I wanted to include in my questions.

Table of Specifications

		Behaviors						Total for each topic
		Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**	
Topics	Factor Polynomials		#1, #2					**2**
	Add, Subtract, Multiply Polynomials		#3, #4, #5					**3**
	Divide Polynomials		#6					**1**
	Total for each behavior	**0**	**6**	**0**	**0**	**0**	**0**	**6**

Reflection on the Assessment's Validity

Based on my objectives and table of specifications, my questions had good content validity. I know what I am trying to assess my students on and I have a good idea on what I am intending to measure. Therefore, my test effectively measured what it was supposed to measure. All of the areas that I want to cover in my objectives are covered and line up with my table of specifications and my test questions. I intend to cover factoring polynomials and adding, subtracting, multiplying, and dividing polynomials. All of these topics are covered in my table of specifications and in a respective test question.

My assessment did not address multiple levels of Bloom's taxonomy. All of my questions were math problems with a straight-forward answer. There was no application of the math problems. The reason for this is because of the objectives that I chose. Polynomials are not a math concept that can be easily applied to a word problem or a more realistic situation. Therefore, being able to accurately complete the assessment only required a level of understanding the material. However, it was required that students understand the material in order to answer the questions, rather than only having to remember a fact. I think for this assessment it was okay that it only addressed one level of Bloom's taxonomy because it was not a super complex objective that was being met. If the assessment had more questions or a more complex objective, then I do think it would have been necessary to address more levels of Bloom's taxonomy.

Keyed Copy of Assessment

1. Factor the following polynomial: $2x^2 - 5x - 12$
   - **a. $\underline{(2x + 3)(x - 4)}$**
   - b. $(2x - 3)(x + 4)$
   - c. $(2x + 4)(x - 3)$
   - d. $(2x - 4)(x + 3)$

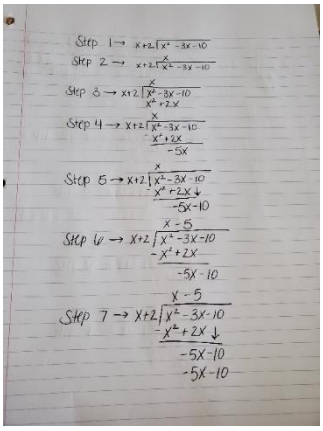
2. Factor the following polynomial: $3x^2 - 5x + 2$
   - a. $(3x - 1)(x - 2)$
   - b. $(3x + 2)(x + 1)$
   - c. $(3x + 1)(x + 2)$
   - **d. $\underline{(3x - 2)(x - 1)}$**

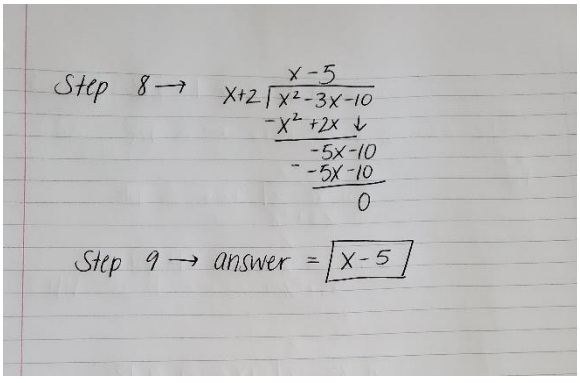
3. Add the two polynomials: $(3x + 4xy - 6y + 5y^2) + (2x^2 - 7x + 3x^2y + y)$
   - **a. $\underline{(3x^2y + 2x^2 + 4xy - 4x - 5y + 5y^2)}$**
   - b. $(3x^2y + 2x^2 + 4xy + 10x - 5y + 5y^2)$
   - c. $(3x^2y + 2x^2 + 4xy - 10x + y - 5y^2)$
   - d. $(3x^2y + 2x^2 + 7xy - 4x + 5y + 5y^2)$

4. Subtract the two polynomials: $(6x^2 - 4x + xy^2 + 8y + 3) - (3x^2 - 2x + 5xy^2 - 2y + 7)$
   - a. $(3x^2 - 6x + 6xy^2 + 6y + 10)$
   - b. $(3x^2 - 6x - 4xy^2 + 6y - 4)$
   - **c. $\underline{(3x^2 - 2x + 10y - 4xy^2 - 4)}$**
   - d. $(3x^2 + 8x + 5xy^2 - 16y + 21)$

5. Multiply the two polynomials and put your answer in simplest form: $(4x^3 + 6x)(x^2 - 7)$
   - a. $(4x^6 - 28x^3 + 6x^2 - 42x)$
   - **b. $\underline{(4x^5 - 22x^3 - 42x)}$**
   - c. $(4x^5 + 34x^3 - 42x)$
   - d. $(4x^5 - 28x^3 + 6x^3 - 42x)$

6. Divide the following two polynomials using long division: $(x^2 - 3x - 10)/(x + 2)$. Be sure to show ALL of your work.





Reflection

My assessment demonstrates good content validity because the question formats align with the behaviors specified in the objectives. This is because for the multiple-choice questions, the students must solve a math question and then find the correct answer choice in a set of options. For the essay question, students must also solve a math question, but they actually have to write out all of the steps to demonstrate that they actually understand how to divide two polynomials. This requires a different format, and it requires students to show me more of their thinking. This becomes more challenging than just circling the correct answer to a multiple-choice question.

The principle of effective test writing I struggled with the most was coming up with answers that were not correct. As somebody who has a math-oriented brain, I found it difficult to come up with ways that students may incorrectly do a problem to then get the wrong answer. In my mind, there is only one answer and that should be the obvious answer, but that is not realistic of how students are going to perform. For the future, I will work on improving my assessment-writing skills, by taking note of how this first one went and learning from this experience. Also, I will work towards learning more about my content area of math specifically and how writing a math assessment may be different than for other areas of learning.

Administration

Procedures and Setting

The people that I had take my test included five of my friends that attend CSB with me and my sister, who is a junior in high school. I assigned two of them to be low-achieving students, two of them to be average students, and two of them to be high-achieving students. My friends Isabel and Emma were my high-achieving students, my friend Carly and my sister Erika were my low-achieving students, and my friends Marla and Torri were my average-achieving students. I used both group and individual administration based on each of their own schedules and my own schedule. I gave the test to Carly and my sister individually, but Emma and Torri are roommates so they both took the test at the same time and Marla and Isabel are roommates, so they also took the test at the same time. This did require me to give the instructions a few different times, but it was just what worked best based on everyone's schedules. This test occurred in their own dorm rooms and my sister took the test in her room at home. The instructions that I gave prior to the test started with me telling them that this is a six-question assessment on polynomials. I informed them that it was an independent assessment, so they should not be consulting any other resources or people during the test. I told them they are allowed to use a calculator and a pencil and that is all that should be with them at the time of this test. I told them that they had 20 minutes to finish the assessment. This was a good amount of time for them to answer the six questions. The only materials that students will have access to is a pencil and a calculator. Although they should not need the calculator, I want them to have access to one because it is a very useful tool in a math setting. Also, the use of a calculator does not inhibit the students from showing me that they do know how to accurately solve the problems. Also, math tests should always be done in pencil, not pen so that if they find errors in their work, they can erase it, rather than scribbling over it. Distractions were minimized by ensuring that the student's phone was put away. Also, there was no music to be played and because it was administered in their dorm room, it was possible to ensure that the room was fairly quiet. Another way that I minimized distractions, was to have them take the assessment in a situation similar to a classroom, meaning at a desk sitting upright in a chair.

Reflection

Some of the strengths of the administration of this test include the instructions that I gave my students. The expectations for the test were clear from the beginning. My students knew they had 20 minutes and were only to use a calculator and pencil and were to not consult their roommate at all. These expectations were simple and easy to understand. These strengths increased reliability and validity because if all students were given the same directions, the results are going to be more reliable and valid. Some of the weaknesses of the administration of this test includes that almost all of these assessments were given in a dorm room, where two people live. Thus, the assessment may not be as reliable if the other roommate was present as a distraction. Another challenge that arose is that this test was administered over the weekend and the last thing students want to do is take a test on their two days off. Therefore, the assessment results may not be as reliable or valid because if a student had little to no interest in taking the assessment, they may have rushed to finish it, resulting in poorer scores.

The administration environment of the dorm room was beneficial, because it was not a public space so there were no unexpected people creating extra distractions or noise. Also, because my friends each live in their own room, it was not a problem to ensure that no music was being played. Although the testing environment was not horrible, taking a test in the same space that you live can always be a challenge. If I were to administer this test again, I would find a place that had very low noise levels with fewer ways to get distracted, such as no other people around, no other homework to work on, no laundry to fold, etc. The fewer distractions there are, the more likely it is that students will perform better on assessments. This will improve both reliability and validity because it will give me a more accurate measurement of what my students know. This is because if students actually perform to the best of their ability, they will be producing valid and reliable results.

Student Scores

Student Name / Pseudonym	Multiple Choice Score *(out of 5 points)*	Essay Score *(out of 3 points)*	Total Score *(out of 8 points)*
Isabel	5	0	5
Emma	5	1	6
Marla	4	0	4
Torri	5	1	6
Carly	3	0	3
Erika	1	0	1
Class Mean:	**4.6**	**.33**	**4.17**
Class Median:	**4.5**	**0**	**4.5**

Reflection

Based on the distribution of scores, my results show what appears to be a fairly normal distribution. Therefore, the mean is a better statistic to report because it is not skewed by outliers. Also, there are no extreme outliers that would be skewing the mean significantly, so the mean is the best statistic to report in this situation. With a mean of 4.17/8, three of the scores are above the mean and three are below the mean, so the mean does a nice job of giving the class average.

The students performed about how I expected them too. The multiple choice was fairly simple and easy for most of them. I did expect them to get tripped up by one of the multiple-choice questions in particular, and they did as I would have expected. All of them who took the assessment did not do well with the essay question. I was a little bit surprised, but not completely shocked. That was the trickiest question by far and if they were to not know how to do one of the questions, the essay question is the one that I would have guessed they would not have known how to do. The one person who did worse than I would have thought is my sister. I am guessing this is because she is younger than everyone else who took the assessment and math is not her strongest subject.

Item Analysis of Multiple Choice Items

Group Identification

	Student Names/Pseudonyms
Upper (high-scoring) group:	Isabel, Emma, Torri
Lower (low-scoring) group:	Carly, Erika, Marla

Item Analysis Calculations

Item Analysis							
Item number	**Groups of students**	A*	B	C	D	**Item Difficulty**	**Discriminating Power**
1	**upper**	3	0	0	0	5/6 = 83%	3/3 – 2/3 = .33
	lower	2	0	1	0		
Item number	**Groups of students**	A	B	C	D*	**Item Difficulty**	**Discriminating Power**
2	**upper**	0	0	0	3	5/6 = 83%	3/3 – 2/3 = .33
	lower	0	1	0	2		
Item number	**Groups of students**	A*	B	C	D	**Item Difficulty**	**Discriminating Power**
3	**upper**	3	0	0	0	6/6 = 100%	3/3 – 3/3 = 0.0
	lower	3	0	0	0		
Item number	**Groups of students**	A	B	C*	D	**Item Difficulty**	**Discriminating Power**
4	**upper**	0	0	3	0	4/6 = 67%	3/3 – 1/3 = .67
	lower	2	0	1	0		
Item number	**Groups of students**	A	B*	C	D	**Item Difficulty**	**Discriminating Power**
5	**upper**	0	3	0	0	3/6 = 50%	3/3 – 0/3 = 1.0
	lower	0	0	0	3		

Reflection on Item Analysis

Using the item analyses calculations, item number 3 is the easiest because every person got it correct. I am assuming that the reason everyone got this correct is because it was asking students to add two polynomials and addition is a very simple concept that students have been doing for many years. Also, there were not a lot of negative numbers, so the math behind the problem was fairly simple. On the other hand, item number 5 was the hardest, with a item difficult calculation of 50%. I believe the reason that this was the hardest question is because it asked students to put their answer in simplest form. If a student missed this part of the question, they likely got the wrong answer. Item number five was the most discriminating with a discriminating power of 1.0. This is likely because the upper group fully read the question about putting the answer in simplest form, which then lead to the upper group getting it correct. Whereas the lower group may not have read the question completely and failed to put the answer in simplest form, resulting in all of the lower group answering the question incorrectly. Item number three was least discriminating with a discriminating power of 0.0. I think this is because again, the problem was simply just adding numbers which is the simplest question on the assessment. Therefore, it was easy enough for the upper group and easy enough for the lower group.

In item number five, letter D may have been confusing for students. However, it did do its job of distracting students. Letter D is a correct answer, but the question asks for the answer in simplest form, which letter D does not do. Based on the item analysis, letter D was a distractor to the lower group, but not the upper group, so it served its purpose well. For item number four, letter A was also confusing for two of the students. Rather than subtracting the two polynomials, both students, added them instead.

One question that I would change in the future is item number three. I would make this a little bit harder by incorporating more negative numbers into the question so that there was a higher discriminating power between the upper students and the lower students. The one thing that I would change about all of my test questions is that they are multiple choice. I do not like having students take math tests with multiple answers to choose from because they can use the answer choices to solve the problem without doing the actual work. This is shown by a few of my students' assessments.

Essay Question

Rubric

Place the scoring rubric here.

Criteria	3	2	1	0
Divide Polynomials	Students were able to accurately show all steps (at least 9) to the problem and got the correct answer of x – 5.	Students were able to show some of the steps to the problem (5 – 8 steps), but still got the correct answer of x – 5 or were able to show all steps (at least 9) to the problem but ended up getting a different answer.	Students were able to show very few of the steps (1 – 4 steps) to the problem and did not get the correct answer or students got the correct answer (x - 5) but only was able to show 1 – 4 steps in their explanation.	Students were not able to show any part of the problem and did not get an answer at all.

Inter-Rater Reliability

Rubric Criteria 1: List the rubric criteria here

Student Name / Pseudonym	Your Rating	Colleague's Rating
Isabel	0/3	0/3
Emma	1/3	0/3
Marla	0/3	0/3
Torri	1/3	1/3
Carly	0/3	0/3
Erika	0/3	0/3

Reflection on the Reliability and Validity of the Essay Question:

My ratings were very similar to the ratings of my colleague. We only differed on one student. I think part of the reason for our success is the fact that nobody knew how to do the essay question, so there was very little work to actually grade, resulting in many zeros. Therefore, it was fairly clear between both myself and my colleague that many of the students deserved a zero. The one reason that we differed is because of how the rubric is worded in one place. Because of this, I would change the rubric for the future. Instead of saying (1 – 4 steps), I would specify that they could have anywhere from 1 – 4 steps to be given those points. My co-rater was confused by this in my rubric. She thought that they had to have all 1 – 4 steps in order to receive a score of 1. My intention was that if students had somewhere between 1 and 4 steps,

they would receive a score of 1. The inter-rater reliability comparisons help me to ensure that my assessment is reliable and valid because I am able to see if I am actually grading students on the content of their work and not another factor. It also helps to ensure that I have a rubric that does an effective job explaining the expectations that I am looking for in the answer.

Overall Reflections

Overall, one strength of my assessment is that it was laid out nicely with good distractors. My distractors were effective in almost confusing students, but not enough for them to get it wrong. They just ensured that students paid close attention to their answer and the multiple-choice options. One weakness of my assessment is that students could solve the problems differently than I hoped, which means I would not have gotten a clear understanding of if they understand the material. This is because the test was multiple choice. Factoring and multiplying polynomials are opposite operations which means that for my factoring questions, students could multiply each of the four answers out and work backwards to figure out the correct answer. However, this no longer is testing their understanding of factoring. If I were to give an assessment like this again, I would not make it multiple choice. Therefore, students would be forced to factor, and I would then have a better understanding of their knowledge on the objectives.

One strength in my assessment is that the questions vary on their level of difficulty. This allows students of all different cultures, socioeconomic status, gender, and learning exceptionalities, to have some chance at success on this assessment. There is the likelihood based on the different levels of questions, that all students will have at least a little bit of success when taking this test. My assessment could have been improved in a few ways in terms of diversity amongst students from different cultures, socioeconomic status, gender, and learning exceptionalities. For students who have learning disabilities, I would alter the amount of time they get to take the test, so that they do not have any constraints to worry about other than taking the test itself. Also, if the student struggles to read, I would allow a teacher to read the test to the student, so they can focus on doing the math, rather than focusing on the inability to read the questions. This can also be done for students who are from other cultures who may not speak English as their first language. For students who show signs of being gifted, I would work with them to create a more challenging assessment in the future or create more intellectually challenging assignments in class. For students of lower socioeconomic status, attendance may be an issue. Therefore, they may not always be at school on test days. I would make accommodations with those students so that they still have the chance to take the assessment. In terms of gender, girls may worry about stereotype threat. This means that they may stress about performing poorly on the test and confirming the stereotype that girls are bad at math. I would instruct my students that they all are mathematicians and are fully capable of having success on this assessment. This assessment does require students to know what it means to add, subtract, multiply, and divide, which are all mathematical skills that should have been taught prior, but some students may still struggle. Therefore, it is important that as a teacher, I make it possible for students to know how to perform these operations before I give this assessment specifically on polynomials. One thing that could be improved in this assessment is that some of the wording in the questions is very technical. Polynomial is a long mathematical term that not all students may have the knowledge to understand. By providing a definition or rewriting the questions, it would allow students who can not comprehend all of the mathematical language to have a better chance of doing well on the assessment. I am aware that there is bias present in all assessments, even without intending to write it in. However, I will continue to try and work on ensuring that my future assessments are free from bias.

Based on the test results that I received, I would revisit dividing polynomials using long division. Not one student got a good score on that problem. I would break this idea down step by step because it is very easy to make a minor error when doing long division. We then would do some practice with this concept, to ensure that my students understand how to accurately solve a problem like this in the future. Another piece that I would revisit, is reminding students what it means to put an answer in simplest form. Although not a big concept that would take a lot of time, it is still important that students know what this means and how to do it because it will come up in every math class they take in the future. We would look at some example of questions and answers and look for the answer in simplest form. Having students do a quick exit ticket with three problems addressing these two ideas, would be a quick check that they have a better understanding of the material after I revisited the topics.