5-2017

Non-Remedial Remediation

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A thesis submitted to the
University Honors Program in
partial fulfillment of the
requirements for the Honors
Diploma

Southern Illinois University

April 27, 2017

Mathematics is an essential part of a student's education. However, there are many items that can stand in the way of some students' mathematical development, of which lack of sufficient background skills is number one. Remediation is a tool that if implemented correctly will benefit all students despite their mathematical abilities. It can be used to nourish and build students' developmental math skills. These skills include but are not limited to: incomplete mastery of number facts, computational weakness, difficulty transferring knowledge, making connections, incomplete understanding of mathematical vocabulary, difficulty comprehending the visual and spatial aspects, and perceptual difficulties. Each year thousands of students who enter college with weak math skills are placed in remedial courses. To encourage the growth of students' mathematical abilities, I believe that remediation needs to be implemented into all math classrooms. If done correctly, students of low mathematical ability will increase their skill level and students who have done well will perform at an even higher level. In past years, the need for college remedial courses in mathematics has increased to unprecedented levels. There have been attempts to establish corrective measures at the high school level, however, all evidence indicates that the problem of mathematical remediation has continued to have a negative effect on colleges and universities. To improve student's mathematical performance and consistency, it is essential that teachers incorporate remediation in their classroom. Implementation of remediation must be executed discretely and consistently. Developing a remedial program in which students are not aware that they are being remediated would be tremendously beneficial for their learning. By creating numerous lesson plans in which material from previous lessons is incorporated, it will allow students to learn new skills while practicing and mastering previous skills. Thus, more students will go from the knowledge level to the skill

level.

The subject of remediation I have chosen is geometry and I will use probability as the tool of remediation. Probability is readily adaptable to all subjects and can be introduced in a manner which teaches new probability concepts while remediating basic geometry concepts. The apparent goal is to learn probability but the underlying goal is to master basic geometry. This paper will introduce the probability topics that will be used to remediate students in the second semester of a standard high school geometry course for various selected topics.

One of the first items that needs to be addressed is determining who most needs remediation. Although beneficial for all, there are certain students who would benefit more from having remediation built into their everyday math curriculum. Unfortunately, due to budget constraints and other political issues, individualized instruction is very difficult to accomplish at the secondary level. That being said, the best solution is to teach new concepts which have the remediation built into them so all students are increasing their knowledge and building essential skills. With the diversity that exists in mathematics, this is a very attainable goal given the teacher has sufficient motivation to do so. As an educator, I will use all resources available to me to ensure that I am covering and remediating the proper topics which will help my students succeed.

WHO NEEDS REMEDIATION?

Education estimates from the National Center for Education Statistics indicate that, depending on the state and the type of institution, anywhere between 16% and 40% of each year's incoming students for any given institution are, to some degree, inadequately prepared for college level academic work (Brier, 1984). A few need to develop their reading and study skills. Some need to develop their writing skills, and many need to develop their mathematics skills. There are many underlying reasons for a student's struggles. First, students with behavioral issues. If a student is failing math because of a behavioral problem, it is almost impossible to help them. Putting these students in a math remediation group with students who truly need remediation might not work out. Teaching students with behavior problems creates a higher demand on the teacher. This puts students with behavior problems at a greater risk at falling behind and once they fall behind they are almost never capable of catching up.

Next are students who lack number sense. If a student does not understand how to compose and decompose numbers, see the relationship between the operations, or lacks a basic understanding of place value concepts, they will undoubtedly fall further and further behind in math. Other students who are in need of remediation are those who cannot apply mathematics. These students often fail standardized tests. They may be able to multiply, but when it is put into a word problem they fall apart. These students must continually see mathematics in context. Students with high mobility rates are also in need of remediation. These students often come to your classroom with huge gaps. As students move around they miss big chunks of learning. Students with high mobility rates benefit from intervention, which can lead them to get back on track. Research has found students generally lose about three

months of reading and math each time they switch schools. “Mobility can be particularly hard on children in the early grades, as they learn foundational skills”. A 2015 New York University study found that out of 381 low-income, predominantly ethnic-minority students in Chicago, 327 changed schools at least once from kindergarten through 4th grade, and 40 students transferred three or more times. The more often students moved the lower they scored on both the state standardized math test and on teacher observations of the students’ critical thinking (Sparks, 2016).

Finally, students with learning disabilities need remediation. Learning disabilities are problems that affect the brain's ability to receive, process, analyze, or store information. These problems can make it difficult for a student to learn as quickly as someone who isn't affected by learning disabilities. These students, despite our best instructional practices and efforts, cannot seem to overcome their struggles. Additional testing is often required to determine if these students require the specialized talents of a special education teacher. One of the issues with these types of students is how to remediate without diminishing what limited self confidence in the subject area that they already have. Remediation, when not done discretely can often be self- defeating.

Early colleges were for an elite few, but college student numbers are continually raising (Parsad & Lewis, 2003) as well as the amount of information needed to succeed today. Students must not only know more, but learn how to deal with the global society amidst vast technological changes. It is very evident that students are entering college not prepared for the level of coursework. A representative from Southeast Missouri State University stated, “Since Southeast Missouri State University is a regional comprehensive university, College Algebra is

not remedial here. Classes below College Algebra are considered remedial instead. With that said, approximately 44% of our entering freshman students need coursework below College Algebra." At Arizona State University, they used to have approximately 1000 students enrolled in Intermediate Algebra every fall semester, but have since did away with all remedial math courses in the fall of 2015.

HISTORY OF REMEDIATION

Thousands of students enter college each year underprepared. In 2004, a study in Ohio revealed that 45.6% of incoming college freshmen students were placed into remedial mathematics courses (Bettinger & Long, 2006). There has never been a time in American education history where all students who enrolled in college were sufficiently prepared. The first known remedial education program involved coursework in reading, writing and arithmetic and began in 1849 at the University of Wisconsin (Phipps, 1998). Remedial education can include an assortment of strategies, such as evaluation, curriculum design and delivery, assessment and placement, and various support services. In 1995, a survey by the National Center for Education Statistics (NCES) found that 78 percent of higher education institutions that enrolled freshmen offered at least one remedial reading, writing, or mathematics course. One hundred percent of public two-year institutions and 94 percent of institutions with high minority enrollments offered remedial courses. Twenty-nine percent of first-time freshmen enrolled in at least one of these courses in the fall of 1995. Freshmen were more likely to enroll in a remedial mathematics course than in a remedial reading or writing course, irrespective of the institution they attended (Phipps, 1998). Today, across the country, millions of students enroll in college every year only to learn that they need to take classes that will not count

toward their degrees because they cover material that they should have learned in high school. These remedial courses cost students and their families serious money-about $1.3 billion across the 50 states and the District of Columbia every year (Jimenez, Sargrad, Morales, & Thompson, 2016). The national rates of remediation are a significant problem. Research shows that anywhere from 40 percent to 60 percent of first year college students require remediation in English, Math, or both (Jimenez, Sargrad, Morales, & Thompson, 2016). Remediation has had an impact on society for years.

ADVANTAGES OF REMEDIATION

A majority of students entering colleges and universities take a test to determine whether they are well equipped for college level work. These placement tests place large numbers of students in remedial education courses, which are very costly and quite often are non-credit classes. These must be completed before beginning or along with, regular college courses. Remediation at the lower levels provides opportunities for students who lack the academic skills to succeed in postsecondary education (Parsad & Lewis, 2003). The aim of remedial teaching is to help students who have fallen behind regain their self-confidence as well as basic skills. There are numerous additional benefits to these types of remediation problems. First the student is learning basic probability. Second, because of their length they increase student wait time for their answer. Student wait time is key to success at higher levels where problem difficulty is elevated due to course demands. The length also forces students to be more organized while working the problem. Organization at times is more important than aptitude when solving difficult problems. Students begin to see how mathematical concepts are related to one another and realize that to succeed in mathematics at any level, requires an

excellent command of all lower level concepts. Remediation offers opportunities for students who lack the academic skills to succeed in postsecondary education.

When remediating students, we must to consider what is the most urgent concept to remediate? Ranging anywhere from simplifying radicals to fraction arithmetic, it can be hard to narrow it down. From a survey given to many secondary math educators, when asked "what do you consider the most challenging math skills for students are?" the most common answer was students struggle with many mathematical concepts such as factoring and simplifying radicals. They believe this has become a major challenge for students since simple arithmetic (adding and subtracting) proves to be extremely difficult for many students. One of the challenging tasks of remediating mathematical skills in the classroom is narrowing down what are believed to be the most crucial concepts. For the purpose of this project I decided that geometry concepts will be the basis for all remediation. There are numerous geometry concepts that can be included in helping remediate multiple mathematical skills**.** Not only during this process do we want to remediate necessary geometry skills through probability, but we need to also build in critical arithmetic skills that seem to post a challenge for students. For example, fraction computation has proven to be difficult for students even in college level math courses**.** In the following example, I chose to review the concept of finding area of multiple figures, there are different examples provided which offer options for varied student abilities.

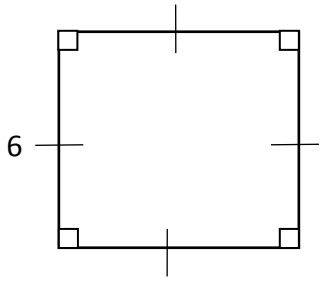
SAMPLE PROBLEMS

As stated before, I have chosen geometry as the subject of remediation and probability as the tool of remediation. We need to assess our student weaknesses and design lessons using probability as a front for remediation and geometry as the tool to help improve student skills.

Lessons need to be built to accommodate student abilities and levels of motivation. With any skill in any area, repetition and continual enhancement are the only way to ensure success. This section will provide various examples which teachers may use in their classroom. Each example provides remediation of multiple skills while presenting the information in a new way to students. The following each represent remediation problems which attempt to accommodate different students at different levels. Difficulty levels are increasing with each example.

Example 1: If two figures are chosen what is the probability their areas are equal?

a)



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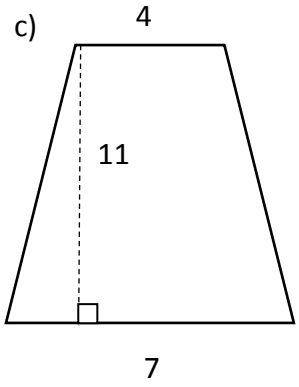

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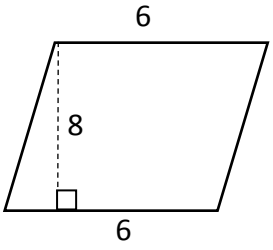

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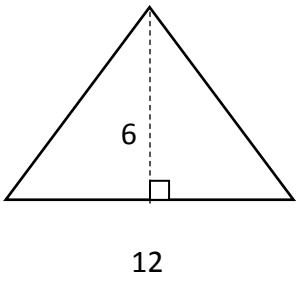


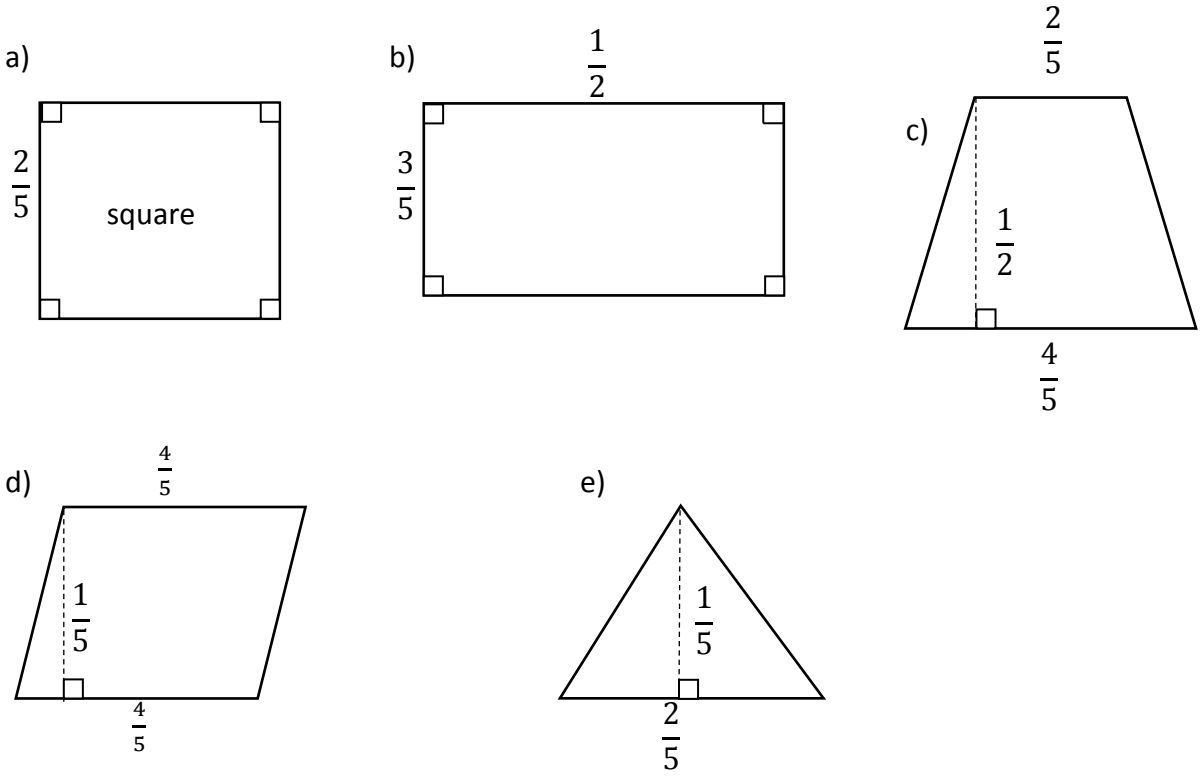
The problem above requires students to know the area formula for each of the given polygons, and be able to perform simple arithmetic.

Example 2: If two figures from the choices below are chosen, what is the probability their areas are equal?

a) A square with a diagonal $6\sqrt{2}$.
b) A rectangle with width 6 and diagonal 10.
c) A trapezoid with height 4 and bases 7 and 11.
d) A parallelogram with height 8 and base 6.
e) A triangle with height 6 and base double the height.

The problem above challenges students to know and understand the definitions of each polygon. The fact that this problem is stated in words without the figures inherently increases the difficulty. Students must be able to recall the characteristics of each polygon and the area formula for each as well as the Pythagorean Theorem.

Example 3: If two figures are chosen what is the probability their areas are equal?

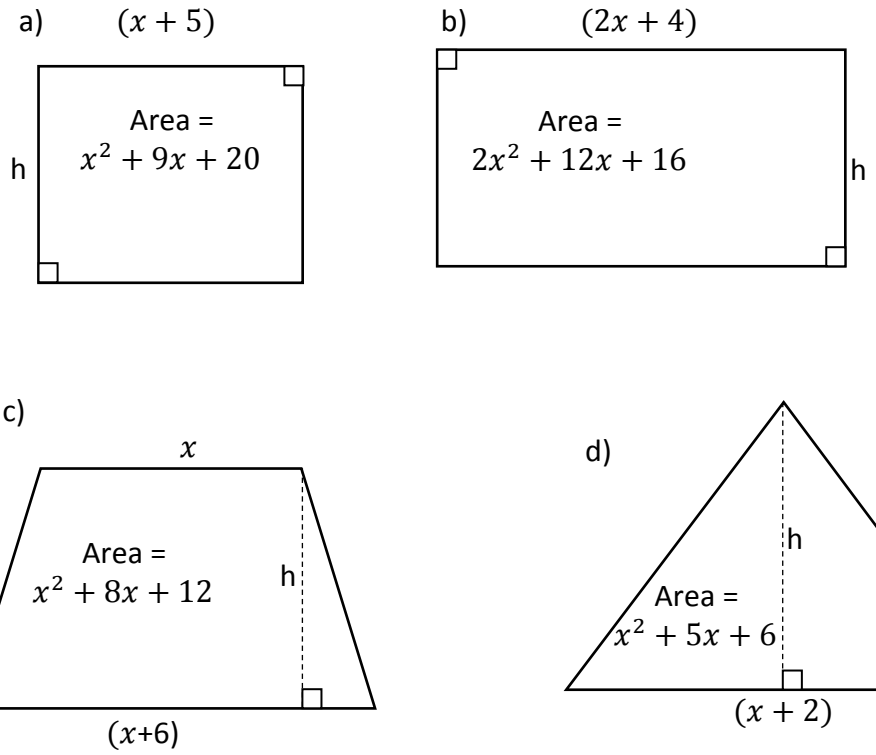


The problem above masking as probability challenges students to recall fraction arithmetic, while also requiring knowledge of basic area formulas.

Now we are going to combine remedial algebra and geometry with probability and get

multiple topics of remediation with one problem. Problems such as these address multiple common core standards and in particular the first one addresses the need to remediate factoring.

Example 4: What is the probability if one of the following figures is chosen its height is x+4?



This problem requires knowledge of probability, factoring, and simple area formulas. The factoring requires competent arithmetic skills. Note that if the teacher desires, when choosing only one figure, it would be possible to have more than 4 figures to promote more repetition. One should note that for example if choosing only one figure from 8 the sample space has 8 members in it but choosing 2 from eight yields 28 events in the sample space, and overcomplicates the problem.

Example 5:

Given the following ratios: 12: 14 22: 55 26: 91 12: 19 13:17. If one of these ratios is chosen at random what is the probability it is in simple form?

Let's analyze the basic skills necessary for completion.

1. Know what simple form of a ratio is
2. Understand basic probability
3. How to find common factors and reduce to equivalent forms

Many students at university levels lack the skills to reduce fractions. Students at high school levels would be offended if they were told they had to do a worksheet on reducing fractions, but problems like this remediate the concept without making students feel ashamed of the work level at which they are performing.

Example 6:

What is the probability that each ratio is in simple form?

a) $(x^2 + 5x + 6)$: $(x + 3)$
b) $(x^2 + 9x + 18)$: $(x^2 + 12x + 32)$
c) $(x^2 + x - 72)$: $(x^2 + 11x + 18)$
d) $(x^2 - 4)$: $(x^2 + 10x + 16)$
e) $(x - 6)$: $(x^2 - 14x + 45)$

Skills necessary:

1. Basic factoring
2. Understand basic probability
3. Reduce to simplest form

Example 7:

If one of the following is chosen what is the probability it factors

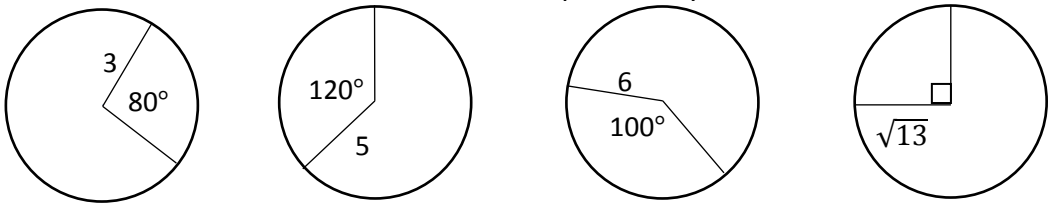
a) $x^2 - 3x - 54$ b) $x^2 + 4$ c) $2x^2 + 9x + 6$ d) $x^2 - 15x + 45$ e) $x^2 - 10x$ f) $x^2 + 3x + 4$

This simple problem requires a student to look at each choice and decide if they can be factored.

Requires:

a) simple probability
b) basic factoring skills
c) basic arithmetic skills

Example 8: If one of the sectors is chosen what is the probability its area is less than 12?



This problem when given without a calculator commands a student to know how to approximate pi as well as compute the area of a sector.

Example 9:

If two of the following sets are chosen what is the probability that they both represent the lengths of the sides of a right triangle?

A = { 3, 4 ,5 } B = { 12, 15, 18 } C = { 9, 40 , 41 } D = { $\sqrt{3}$, $\sqrt{4}$, $\sqrt{5}$ } E = { 1.6 , 3 , 3.4 }

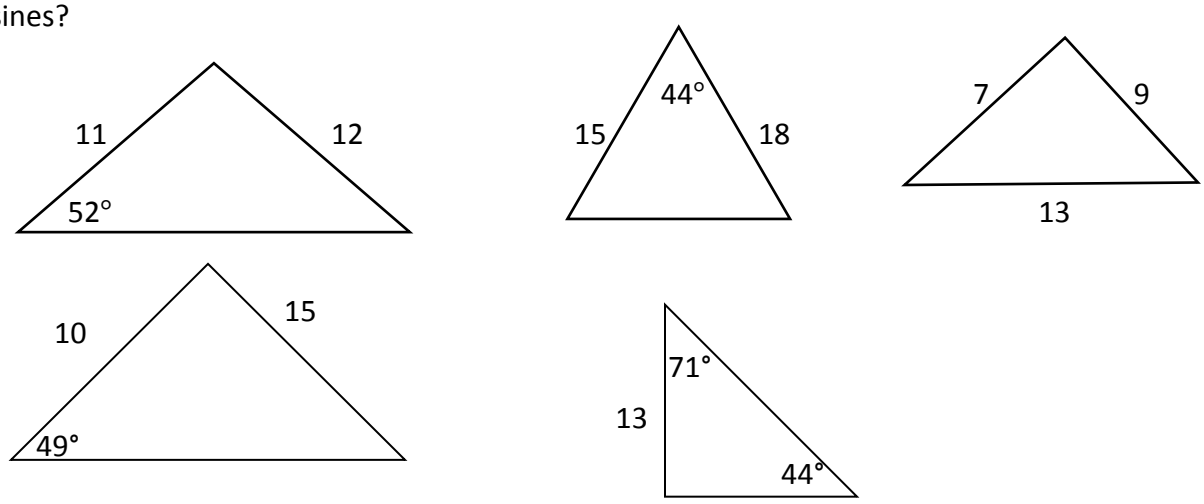
Sample space { AB, AC, AD, AE, BC, BD, BE, CD,CE,DE } ans: 3/10

Skills necessary for completion:

1. Knowledge of the Pythagorean Theorem
2. Ability to correctly list a compound sample space/ simple probability
3. Basic integer and radical computation
4. Properties of similar triangles/basic arithmetic

Example 10:

If a triangle below is chosen what is the probability it must first be solved using the law of cosines?



Required skills:

1. Basic probability
2. Thorough understanding of the laws of sines and cosines.

Note: This is an excellent problem for average students taking trigonometry as they generally struggle with when to use which of the two laws. In this case students may very well know both laws but have never studied when they are to use which one.

CONCLUSION

Student achievement, including math skills, remains unacceptably low (Haycock, 1996). Students are not retaining the information or are not getting the concepts at all. Too frequently students arrive at college unable to compute easily or think critically and this is especially true of minorities and students from low-income families, but the phenomenon is not restricted to them (Haycock, 1996). The purpose of this thesis is to give educators skills and ideas needed to assist every student no matter their age, ethnicity socioeconomic status, or ability. It is crucial to hold developmental math students to high standards so they have the tools to succeed. Under-prepared students need to be actively engaged in talking and working problems and they need to gain confidence. By providing numerous examples in which educators can use and modify in their own lessons, it gives teachers a way to provide students with the chance to receive support, review basic skills, and aid in the mastery of skills. This type of remediation does so in an innocuous manner and preserves a students' feeling of self-worth.

The sample problems presented were only a fraction of the ones used for different types of remediation. My foremost intent is to present this concept and these types of problems at future teacher in-service conferences to promote non-remedial remediation. Because of its widespread adaptability and flexibility probability gives teachers numerous options to engage in

remediation discretely. As a beginning teacher I intend to implement such remediation and encourage my peers to take advantage of this option for remediation.

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