Dr. Al Gebra

Summary

Students watch a short role play in which a doctor performs an operation on a patient without first diagnosing his condition.
They relate this medical malpractice to a mathematician performing an operation before evaluating conditions or deciding what outcome he wants.
Next they practice 'diagnosing' X's condition and performing the correct inverse operation to get x by itself.

Main Core Tie

Secondary Mathematics I

Strand: ALGEBRA - Reasoning With Equations and Inequalities (A.REI) Standard A.REI.3

Time Frame

1 class periods of 45 minutes each

Group Size

Large Groups

Materials

Background for Teachers

This lesson is designed for students who have some experience solving equations.
It is aimed at students who misunderstand the role of inverse operations in solving equations or who have picked up bad habits.
For example, some students *multiply* by the inverse every time they see a fraction in an equation, even if the fraction has been *added* to the variable.
Other students, *add* the inverse of every negative number they see even if the variable has been *multiplied* by the negative number.

Student Prior Knowledge

Students should know how to perform basic inverse operations: add, subtract, multiply, divide. They should know what a multiplicative inverse is and what an additive inverse is. The lesson covers these topics, but the emphasis is on deciding when to use which operation.

Intended Learning Outcomes

Become proficient problem-solvers by selecting appropriate methods.

Instructional Procedures

Preparation:
Place two chairs face to face at the front of the room to serve as a doctor's office examining table. Have a large pair of scissors ready. Ask a student to play the role of a kid who has a stomach ache. (Dress as a doctor or elaborate as much as you want. You may want another student to be his mother and bring him in to the office, for example.)
Introduction:
"In a moment I will be playing the role of Dr. Gebra. One of our class members has a stomach ache

and his mother is going to bring him into my office for help." Tell students that they will be asked to comment on the role-play that they are about to see.

Role Play:

Welcome the student and mother with a handshake and friendly smile. Introduce yourself and ask the name of the patient, but do not ask him or his mother anything about his symptoms.

Ask the mother to wait in the waiting room and have the student sit on the examining table.

"Well, I'm ready to begin. I've got my scalpel here (pull out a big rusty saw or a pair of scissors), if you'd just extend your right leg."

Pretend to cut off the student's foot and toss it in the garbage can.

"I hope that takes care of your problem. Let me help you off the table. Your mother is in the waiting room. It was very nice to meet you."

Discussion:

What do you think about Doctor Gebra?

What were some things he did wrong?

(He didn't examine or question the patient before operating. He didn't know what was wrong with the patient. He didn't perform the correct operation to fix the patient's problem. When he was done operating on the patient he didn't bother to find out if he had solved the patient's problem.)

What do we call a doctor like Doctor Gebra?

(A quack)

How would that appointment have gone if Dr. Gebra had been a good doctor?

(He would have found out that the kid had a stomach ache. He would have figured out why. He probably wouldn't have operated unless he found out that the kid had a ruptured appendix. He definitely would not have cut off the kid's foot. After performing an operation he would have kept the kid around long enough to figure out if the operation was successful. He may have had to do another operation. He would have made sure that the cure matched the sickness.)

You have just seen Dr. Mal Gebra operate: Mal as in malpractice. Sometimes when a person is solving an equation he behaves a lot like Dr. Mal Gebra, operating with out thinking. This is not good!

In this class, we don't want any quacks; you are going to learn how to be like Mal's good twin Al: Dr. Al Gebra.

To simplify things we are going to say that your patient is always called X. X comes to see you with a variety of complaints, but they all boil down to one thing: X wants to be alone.

When X arrives at your office what will you do?

(Check to see if X is alone. If not, look at him long enough to figure out why not. Has he been multiplied by a number, divided by a number, had a number added to or subtracted from him? In summary, diagnose X's problem before operating.)

What will you do once you know X's problem?

(Get X alone by doing the inverse operation. The inverse operation is the one that cures the problem which the doctor diagnoses.)

Note: $1X \pm 0$ here the X is alone. There is only one of him. He is not divided into pieces. He has 0 followers.

How will you know that you have successfully cured X?

(After you operate, you will know that your operation has been a success if you have created zeros and ones--additive and multiplicative identities--in the appropriate spots.)

Guided Practice:

Students will write the information that appears below in parentheses on individual white boards. You may want to have an overhead transparency that you fill in as the activity progresses. It could have these headings for four columns: symptom, diagnosis, prescription, follow-up.

Go through all four operations: +, -, â€¢, Ã· .

Only an example of addition is given.
First, have students practice diagnosing X's problem.
Example: X + ½
(X has ½ added to it.)
Second, have students prescribe the correct inverse operation.
Example: X + ½
X has ½ added to it. (Subtract ½.)
(Students may point out that is another possible cure: adding -½. Discuss this idea and add it to your chart. There will be other instances with more than one cure, such as dividing and multiplying by the inverse. Discuss these.)
Third, have students perform the inverse operation and make sure that the operation was successful: (it produced the additive or multiplicative identity, depending).
Example: X + ½ X has ½ added to it. Subtract ½. (X + ½ - ½ X + 0)
Note: Tie back to the doctor analogy as you go to make the lesson more fun and more memorable.
Example:
X is in your office again. He's miserable.
X: I've got this weird fellow stalking me everywhere I go--help me Dr. Al Gebra! I just want to be alone.
Dr. Al: Never fear! I know what's wrong with you; you have ½ added to you, but it's your lucky day--I can cure that with an operation of subtracting ½.
Closure:
Ask students to think of at least three ways that the doctor idea relates to getting X alone mathematically.
Have them turn to a partner and share the ideas they thought of.
Randomly draw names and have students share one idea their partner said.
Ask if there are any ideas that haven't been mentioned yet. Take responses from volunteers.
Tomorrow we will be using our Dr. Al skills to solve equations.
Application and Assessment:
(You may do this part of the lesson on the first day if you have time.)
After a review of this lesson (and a reminder to students about performing the same operation on both sides of an equation), the next lesson will be spent solving equations for X on individual whiteboards. Typically as soon as students shift their focus to performing the same operation on both sides of the equation, many begin to make mistakes. They forget to "diagnose X's illness" before operating. Also they forget to follow-up and see if the operation was a success--they write the operation on both sides of the equation, but they really only perform the operation on the side without X, so they don't see if they produced a 1 or a 0 as needed.
Stop the activity frequently to discuss student mistakes. It's great to have secure students tell what they did and why it didn't work: "I forgot to diagnose," but you can also write student errors anonymously on the board. Then ask the class for feedback, "I see this; what do you think?"
Note: This is a lot more fun and a better learning activity if you tie it back to the role-play. Uh-oh Billy just cut off someone's foot!!! Oh no, I see some quacks operating in the third row. Why won't multiplying by the inverse of ½ work here? Remember guys - you don't want to be a quack - don't forget to diagnose before you operate.

Authors

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