|  |
| --- |
|  |
| Literacy Strategies |
| **for Teaching Mathematics** |

|  |
| --- |
| Nathaniel Nauman  |

Table of Contents

**Introduction2**

**Think/Pair-Share3**

**Think-Alouds4**

**Graphic Organizers5**

**Split-Page Notetaking7**

**Exit Slips8**

**Student Questions for Purposeful Learning (SQPL)9**

**Vocabulary Tree/Vine10**

**Word Grids/Semantic Feature Analysis (WG/SFA)11**

**Tossed Terms12**

**Vocabulary Cards13**

**Crumple It Up14**

**Introduction**

 This Content Area Literacy Resource, commonly called a Strategy “Toolbox,” is a resource designed for Secondary Mathematics Educators that will assist these teachers by providing them with a concise but comprehensive way to locate and understand various literacy strategies useful to teaching mathematics. This idea of course raises the question, why should Mathematics Teachers even think about teaching their students to be literate? After all, is it not the English Teachers jobs to teach students how to read better? To answer these questions, first note that literacy can be defined as – a social practice that involves being able to use and understand symbols and terminology required to communicate within a given context. In the case of a mathematics classroom, the context is obviously the mathematics class and the various mathematical symbols and terminology that we use are clearly something that Mathematics Teachers are the most qualified to teach their students how to be literate in mathematics; because these teachers are the people who are also experts in mathematics, not the English Teachers. This means that it is very important for Mathematics Teachers to keep literacy in mind while they are teaching because, if their students are not literate in mathematics, then these students will struggle to understand the various symbols and terminology that are woven throughout mathematics. Then as a result, these students will not be able to communicate in the “language of mathematics” as well as they could be able to communicate. This will then make it difficult for these students to learn and understand mathematics as easily or as thoroughly as they are actually capable of learning and understanding mathematics.

 Hopefully the above argument has convinced any Mathematics Educators who are reading this, or anyone else who is reading this, that it is very important to develop students’ literacy in mathematics and that it is the Mathematics Teacher that is the best and most qualified person to do this. Furthermore, hopefully the literacy strategies provided below will prove to be beneficial to any Mathematics Educators who are reading this Mathematics Literacy Resource.

**Think/Pair-Share**

*Description:*

The Think/Pair-Share strategy starts simply with a teacher prompt or point that can be discussed by the groups of two or three students that they must break into for this strategy. They then discuss what they think about the topic of the prompt, which may or may not include concepts, problems (including homework), and more. The topic is then discussed as a class.

*Purpose:*

This highly versatile strategy can be used for just about any topic and does an excellent job of promoting peer interaction and collaborative learning between students. Since this strategy gets every students involved, this is great for creating a more inclusive classroom and more peer teaching/review opportunities. It can also be an effective classroom management strategy if the teacher uses it to keep two or three “trouble” students from working together.

*Implementation:*

 First students must be given a prompt or a point of discussion by the teacher. Then they break into groups of two or three and proceed to think about and discuss the topic in question. Finally, the teacher will bring the students into a class discussion about the topic.

*Mathematics Example:*

 This strategy can be useful for having students explore a new concept that is related to previously learned material and having them try to draw connections between the two concepts. It can also be very useful for having students work on problems, so that a student can just ask their partner if they get stuck, which should prove to be beneficial to all students involved.

*References:*

MacKenzie, Sarah. Class lectures in EDUC 240: Literacy and Learning in the Diverse Classroom. Lewisburg, PA: Bucknell University, Spring Term 2012.

**Think-Alouds**

*Description:*

The Think-Aloud strategy is basically where the teacher reads a paragraph/sentence/ equation out loud to the students, and then stops reading and says what he/she thinks about what was just read.

*Purpose:*

 The purpose of this strategy is to give students an opportunity to hear the thought process of someone who is a “master” of the material being read. This provides students with an opportunity to develop their understanding of the material while also giving them an effective way to approach the type of situation/problem that was just read.

*Implementation:*

 First the teacher reads a paragraph/sentence/equation out loud to the students. The teacher then stops at the first good breaking point, the end of a thought, idea, sentence, equation, etc. After stopping the teacher tells the students what he/she thinks about this and then moves on to reading the next section and repeating the process.

*Mathematics Example:*

 This strategy can be useful for helping students to “walk through” a mathematics problem. This helps students to understand how to solve the problem better than just telling students what to do next because with this method students will better understand why this problem is solved like this and an effective method for how to approach the given problem.

*References:*

Fisher, Douglas et al. “Think-Alouds.” In *50 Content Area Strategies for Adolescent Literacy.* Upper Saddle River, NJ: Pearson Merrill Prentice Hall, 2007. 129-131.

**Graphic Organizers**

*Description:*

Graphic organizers are probably one of the most useful strategies for any content area. Graphic organizers are basically a handout that has been set up in a way that promotes a clear and organized set up of information. Some graphic organizers are boxes with a few words in them that designate what kind of information students are supposed to put inside that box. Some are boxes or circles with connecting lines to show how one idea/concept/equation is related to another piece of information. Graphic organizers can be made by the teacher using them for a specific task that he/she has in mind, or many different graphic organizers can be found on and printed off of the internet. Some graphic organizers have become so widely used that they have even developed their own specific names. Such as pattern guides which help to draw connections between various items/concepts that follow a specific pattern, KWL charts that help students document their learning progress throughout a lesson, concept maps that help to draw various connections from one or a few central concepts, and adjunct displays which helps students see how various concepts/words/etc. are related before the lesson is even taught.

*Purpose:*

 The purpose of graphic organizers, no matter what type or style they are, is to assist students in the process of learning new material in an organized manner that helps students to draw connections between multiple concepts/ideas/words/equations/etc. Graphic organizers also help students to keep clear and organized notes that they can refer back to later to quickly review and recall the information.

*Implementation:*

 The implementation may vary from graphic organizer to graphic organizer, but as a general rule they follow the following steps. First the teacher makes or obtains the graphic organizer, obviously. He/she then proceeds to give a copy to each student, at the time when it will be most useful and effective. Then the students will study from/write on/etc. the graphic organizer in order to assist them in their learning of the material being taught.

*Mathematics Example:*

 As was written in the description of graphic organizers, they are probably one of the most useful strategies for any content area, including mathematics. In math graphic organizers can be used to draw connections between various concepts/words/equations/etc., to help students organize information in an organized and easy to understand way, and many do many other things that will assist students in their learning.

*References:*

Fisher, Douglas et al. In *50 Content Area Strategies for Adolescent Literacy.* Upper Saddle River, NJ: Pearson Merrill Prentice Hall, 2007. 3-6, 10-14, 50-52, and 67-70.

Toll, Taylor. Class presentation in EDUC 240: Literacy and Learning in the Diverse Classroom. Lewisburg, PA: Bucknell University, Spring Term 2012.

**Split-Page Notetaking**

*Description:*

This strategy is where someone, usually a student, splits up a page that they are going to use to take notes on by creating a box at the top of the page for a title, date, and other basic information about who, what, where, and when. The rest of the page is then divided by a line that creates a relatively small box on the left side of the page, which is important words or concepts, while the larger right side of the page is filled with more details and other information related to the major concepts and words on the left.

*Purpose:*

 The purpose of this strategy is to give students an organized and effective way to write notes on new information. This will help them to identify what the important concepts are and what the supporting details of each topic are, as well as other noteworthy information.

*Implementation:*

 First the teacher teaches the student(s) learning to use this strategy how it works by explaining it and giving them examples of it. Then students work at using this strategy and ask the teacher for assistance if they have questions at any point, until they master this strategy and are able to use it at will.

*Mathematics Example:*

 Students who know how to use the split-page notetaking strategy can organize their notes so that it is quick and easy to identify the various topics and important words that were learned, and what the supporting details and examples are in the student’s notes.

*References:*

Fisher, Douglas et al. “Split-Page Notetaking.” In *50 Content Area Strategies for Adolescent Literacy.* Upper Saddle River, NJ: Pearson Merrill Prentice Hall, 2007. 114-117.

Ma, April. Class presentation in EDUC 240: Literacy and Learning in the Diverse Classroom. Lewisburg, PA: Bucknell University, Spring Term 2012.

**Exit Slips**

*Description:*

This strategy is used in the last few minutes of a class. It is basically a piece of paper with a prompt that asks students to document what they have learned or not learned, (2) emphasize the process of learning, or (3) evaluate the effectiveness of instruction. The answer to this is written down and returned to the teacher before leaving the classroom.

*Purpose:*

 The purpose of exit slips is to help students reflect about what they have learned and ask questions about something that they do not understand in a format that they will likely not be embarrassed by, no matter what personality they have, and to give the teacher a quick, easy and comprehensive formative assessment of all of the students in his/her class.

*Implementation:*

 First the teacher gives the students the exit slips and a prompt or topic for them to write about, although this prompt can be as general as “do you have any questions about the material that we have learned today” or “what did you find to be the most interesting thing about this unit.” Then the students think about and write down their response, which they then turn in to the teacher. The teacher can then review the responses if he/she thinks that it would be useful.

*Mathematics Example:*

 After teaching students about a tough-to-understand topic, the teacher can have his/her students fill out exit slips about what they had trouble understanding or what they found to be most interesting about the topic.

*References:*

Fisher, Douglas et al. “Exit Slips.” In *50 Content Area Strategies for Adolescent Literacy.* Upper Saddle River, NJ: Pearson Merrill Prentice Hall, 2007. 27-28.

**Student Questions for Purposeful Learning (SQPL)**

*Description:*

This strategy is used to generate questions about material. This is done by using an SQPL statement that the teacher provides to help students to think about a specific topic and to try to develop questions related to that topic, usually in small student groups. Then these questions are brought out to the entire class so that a list of questions can be developed for students to keep in mind while they are learning the material. While this strategy is most commonly used before teaching new material, it can also be used to help students to review material as long as the topic that needs to be considered is not understood as well as it could/should be by students, and they realize this point.

*Purpose:*

 The purpose of this strategy is to help students to consider and develop questions about a topic before it is taught. It can also be used to focus review of tough-to-learn material.

*Implementation:*

 First the teacher creates the SQPL statement that will promote questions about the topic in question. Then the teacher presents this statement to the class and the students break up into small groups and develop questions about the statement, and the related topic. These questions are then kept in mind while the students learn/review the material about this topic, and noted when one of the questions is answered or is in some way brought up in the material.

*Mathematics Example:*

 After teaching students about a tough-to-understand topic, the teacher can have his/her students write questions about a provided SQPL statement. These questions can then be addressed in a manner that will promote understanding about the topic.

*References:*

Fisher, Douglas et al. “Student Questions for Purposeful Learning.” In *50 Content Area Strategies for Adolescent Literacy.* Upper Saddle River, NJ: Pearson Merrill Prentice Hall, 2007. 120-122.

**Vocabulary Tree/Vine**

*Description:*

A vocabulary tree or vine is a strategy that starts with one given core concept/idea/word, and then builds a “tree” or a “vine” using related concepts/ideas/words in the “branches” of the “tree” or in the “leaves” of the “vine.”

*Purpose:*

 The purpose of this strategy is to help students to review learned material and to draw connections between various aspects of the topic in question.

*Implementation:*

 First the students are given a piece of paper, some space on the board, or somewhere/thing else to write on so that they can create a vocabulary tree/vine. Then the students are given a core concept/idea/word and asked to draw a tree or a vine consisting of related concepts, ideas, words, or even equations. This then may or may not be followed by a discussion.

*Mathematics Example:*

 After teaching students the last topic in a unit, the teacher gave the students the title of the unit as the core concept/word(s) around which they drew vocabulary trees/vines about the various related material that they had learned throughout the unit, and perhaps even about some other topics related to the unit.

*References:*

Eckard, Kenneth. Class presentation in EDUC 240: Literacy and Learning in the Diverse Classroom. Lewisburg, PA: Bucknell University, Spring Term 2012.

**Word Grids/Semantic Feature Analysis (WG/SFA)**

*Description:*

As its name implies, this strategy uses teacher constructed or teacher-student co-constructed word grids that will relate various words/concepts/equations to other words/concepts/equations and decide exactly what kind of relation it is that each pair has with each other. Note that this strategy is more rigid and allows less creativity than the Vocabulary Tree/Vine strategy, but also helps students realize how things are related instead of just noting that they are related.

*Purpose:*

 The purpose of this strategy is to help students to review learned material, to draw connections between various aspects of the topic in question, and review the kind of relationship that each pair of words/concepts/equations has with each other.

*Implementation:*

 First the either the teacher makes and provides a word grid, or the word grid is co-constructed by the teacher and the students. Then students fill out the word grid in order to learn/review which words/concepts/equations are related and how they are related. Then the teacher can go over it in class and correct any mistakes/misconceptions, or the teacher can collect the word grids in order to get a formative assessment of what the students understand.

*Mathematics Example:*

 After learning about the differences and similarities between linear and quadratic equations, or just about anything else, a “word” grid could be created comparing various linear equations, quadratic equations, vocabulary words, and more.

*References:*

Fisher, Douglas et al. “Word Grids/Semantic Analysis.” In *50 Content Area Strategies for Adolescent Literacy.* Upper Saddle River, NJ: Pearson Merrill Prentice Hall, 2007. 140-143.

**Tossed Terms**

*Description:*

The tossed terms strategy is a great review strategy that is great for helping students to review material that they have already learned. Basically the teacher uses a small box with six terms or ideas and then the students can roll this box in class and review whatever material is related to the word(s)/equation that is face-up. The teacher can then check and correct student understanding while the students are reviewing.

*Purpose:*

 The purpose of this strategy is to help students to review previously learned material in a unique and enjoyable manner that will keep students engaged and interested in what they are doing.

*Implementation:*

 First the teacher must make/obtain enough small boxes for what the teacher has in mind. (How many students will share a single box?) Then the teacher can write the six words/equations on the six sides of the box and give them to the students in class. The students will then toss the boxes and review whatever material is face-up, then repeat this process until the students feel satisfied with the their understanding of the material represented on the box.

*Mathematics Example:*

 After learning about the differences and similarities between linear and quadratic equations, or just about anything else, tossed terms boxes could be created with various vocabulary/equations/concepts written down on the six sides that students can then use to review the material in an engaging way that should help to keep all students interested.

*References:*

Fisher, Douglas et al. “Tossed Terms.” In *50 Content Area Strategies for Adolescent Literacy.* Upper Saddle River, NJ: Pearson Merrill Prentice Hall, 2007. 132-134.

**Vocabulary Cards**

*Description:*

Vocabulary cards are, as the name implies, meant for improving students’ understanding of and ability to remember various vocabulary words, which it can also be used for in mathematics. However this strategy can also be modified to study equation types and other mathematical concepts by writing equations in the “word” box of the vocabulary card. The set-up of vocabulary cards are to (1) has a word/equation in the middle, a definition box, a characteristics box, an examples box, and a non-examples box, or (2) have a word box, definition box, illustration box, and non-example box.

*Purpose:*

 The purpose of this strategy is to help students to learn and/or review the a specific vocabulary word/concept/equation in a clear and organized manner that helps students to understand exactly what the given word/concept/equation is and what it does or does not mean.

*Implementation:*

 First the teacher gives the students index cards, 1 index card for each word/concept/equation per student. Then the teacher teaches the students how to set-up and use this strategy. After this, the teacher gives students a word/concept/equation and the students follow the given pattern to develop a clear and through understanding of it. This process is repeated for each word/concept/equation that the teacher and/or each student want to cover.

*Mathematics Example:*

 After learning about quadratic equations, or just about anything else, a teacher could have students use this strategy by giving them the generic quadratic equation ax2 + bx + c = 0 and ask them to fill out what they know about equations of this form in their vocabulary cards.

*References:*

Fisher, Douglas et al. “Vocabulary Cards.” In *50 Content Area Strategies for Adolescent Literacy.* Upper Saddle River, NJ: Pearson Merrill Prentice Hall, 2007. 135-137.

**Crumple It Up**

*Description:*

This strategy is a very useful, versatile, enjoyable and engaging strategy that promotes involvement of all students in the learned material. This strategy starts with something written down on a piece of paper which the students respond to, and then the student crumples it up into a ball and throw it into the middle of the circle that students have formed. The student then picks up another student’s response to a different initial prompt and repeats the process until the teacher says that it is time to end the activity.

*Purpose:*

 The purpose of this strategy is to help students to review and/or practice learned material in a fun and engaging manner that will keep students interested in what they are doing.

*Implementation:*

 First the teacher writes a prompt on a piece of otherwise blank paper. Then writes a different prompt on a different piece of paper, and repeats this process until he/she has enough prompts for the activity that he/she has in mind. In class, the teacher has the students get in a circle, gives a prompt to each student and, if the students are not familiar with this strategy, then explains what they do. The students then write a response to the prompt that they have and crumple the paper up into a ball that they then throw into the middle of the circle. Each student gets up and grabs someone else’s paper ball and goes back to their seat and responds to that prompt, as well as the other student(s) responses when appropriate.

*Mathematics Example:*

 After learning about polynomials, the teacher has his/her students use the crumple it up strategy with polynomial problems written on each piece of paper to have them practice what they have learned, each student writes one step and, if they think a previous step is wrong, circle it and continue solving the problem from there.

*References:*

MacKenzie, Sarah. Class lectures in EDUC 240: Literacy and Learning in the Diverse Classroom. Lewisburg, PA: Bucknell University, Spring Term 2012.