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Sociocultural Theory and its Educational Application

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"I pledge on my honor that I have neither given nor received unauthorized aid on this assignment."

Table of Contents

Introduction

When the US was first colonized, basic literacy was all that was required of formal education (Westby & Torres- Velásquez, 2000). This means that the students only needed to pronounce the words on a page and provide the teacher with an agreed upon meaning for those words. Now, a more dynamic form of literacy is expected from students. Dynamic literacy requires cumulative reference across texts and subject areas as well as accumulation of knowledge over time, i.e. growth (Westby & Torres- Velásquez, 2000). In today's world of high stakes testing the value of the learning process can get lost. This paper seeks to explore the importance and practical application of the sociocultural theory and elements within this educational and psychological theory. The theory and methods within it encourage teachers and students to explore the mathematical world together through collaboration and communication. There are many practical applications of sociocultural theory, all of which encourage the instructor and student to view learning as a process and not a product or score on a final exam. The process itself is culturally specific and teachers need to be sensitive to this, but teachers who understand the sociocultural theory and use its research based instructional methods are more likely to offer diverse learning activities therefore reaching each student where she is and assimilating her into the established classroom culture (Eun, 2010). The same thing can be said about students as well. When students understand how and why sociocultural theory is used, they are more likely to be active in the learning process and no longer merely passive learners (Eun, 2010; Lau, Singh, & Hwa, 2009). Helping students build self-reliance in learning and self-confidence in life are two unspoken goals of the educational system and using sociocultural theory in the classroom can accomplish both.

Problem statement

Higher order thinking and cognitive development first occur on the social level between peers and are then internalized on the individual level (Albert, 2000; Lerman, 2001; Tzuriel, 2000). If this is in fact the case, as research has shown, then learning and development are social processes and neither can be separated from the social contexts (Albert, 2000). Research by David Tzuriel (2000) has shown the process of cognitive development to be two phase. First, a child experiences things at the social level and then, secondly, internalizes those learned functions through the guidance of a knowledgeable peer or adult. The child takes on more independence as the adult continues to modify their level of guidance until the child is fully independent in their learning (Tzuriel, 2000). This method of development defines the zone of proximal development model and its application within the classroom. One can see immediately the heavy reliance on collaboration amongst peers and a need for quality communication with the teacher or instructor to develop a high quality of understanding. Research continues to show the benefits of communication and collaboration in the mathematics classroom. However, many math teachers find it challenging to utilize these elements of sociocultural theory. Teachers are the guiding force for young people, so opportunities to strengthen problem solving skills and deepen mathematical understandings while in grade school may be lost if this new classroom culture is not embraced.

Rationale

Teachers, pre-service and practicing, are encouraged to think about Bloom's Taxonomy when planning their lessons and assessing their students. In brief, Bloom's Taxonomy refers to the need to challenge students in such a way that they are encouraged to use higher order

thinking to solve the problems placed before them (Anderson & Krathwohl, 2001). Higher order thinking is encouraged when students are required to create, analyze, discuss, and evaluate concepts instead of merely regurgitating facts. This tends to be a problem in the majority of mathematics classes today. The traditional form of instruction is typically comprised of lectures where students are told facts that appear to have nothing to do with their daily lives and are then asked to recall those facts for the various standardized tests, and finally move on to the next topic where the process begins again. This method of instruction is no longer considered best practice and is in fact frowned upon by many school districts. Hoever many teachers do not know what else to do in a fact based subject such as mathematics. The methods within sociocultural theory can solve this problem. In the midst of various states and school districts revising their expectations, it is important for teachers to understand that students develop mathematical thinking skills the same way humans develop cultural understandings, by participating in the language and sharing ideas amongst peers (Steele, 2001). To many, this generalization may be thought of as common sense, but to others it is ground breaking and goes against how they were taught and how many currently teach. While it can be a daunting task to revise one's pedagogy, shifting from traditional instruction to contemporary will benefit students immensely.

Research Questions

1. What is sociocultural theory?
2. What are the methods within sociocultural theory?
3. How are these methods utilized?
4. What are the benefits of using sociocultural theory within the classroom?

Literature Review

What is Sociocultural Theory?

Sociocultural theory is based within Lev Vygotsky's research of the formal and informal levels of development and their intersection with educational practice (Eun, 2010). The theory emphasizes the importance of each individual's internalized culture and how it impacts their development. Vygotsky found that in order to understand a student's cognitive development, you must first understand their social, cultural, and historical background (Tzuriel, 2000). Since children come into the classroom with a wealth of knowledge and personal experience based on their cultural understandings to that point, each student will therefore be bringing a different point of view or, at the very least, they will bring varying perspectives within the accepted point of view. Having thirty or more points of view and/or levels of understanding within one classroom can pose a problem for teachers. Deciding where to begin and how to reach each individual can feel overwhelming at times. Sociocultural theory offers methods for reaching each student exactly where they are while offering relief to teachers who feel lost. While Vygotsky did not specifically outline the role of the teacher or instructional adult, further research paired with refined assumptions has provided more insight into this role within sociocultural theory (Arievitch & Haenen, 2005).

The theory states that teaching and learning are collaborative processes (Eun, 2010) with a heavy reliance on communication and participation of each individual (Steele, 2001). The teacher is responsible for guiding student collaboration and providing the tools necessary to learn. It is also up to the teacher to determine the readiness level of each student and differentiate instruction based on these findings. Sociocultural theory accomplishes this goal by

using tools to identify student readiness and current level of development and then teaching just beyond that level. The main tool within the sociocultural theory is the zone of proximal development which encourages students to collaborate with their teacher and knowledgeable peers in an effort to further their problem solving capabilities and increase independence. By using this tool, teachers will become more sensitive to each student's current level of understanding and will be able to enable them to learn concepts that were initially beyond individual comprehension (Eun, 2010).

The Zone of Proximal Development

The zone of proximal development (ZPD) is not a concrete phase that can be seen or measured in a tangible way. It is a symbolic space involving individuals, their practices, and the circumstances of their activity (Lerman, 2001). ZPD is the difference between what a child can do with expertise and what is still out of reach. Many researchers have developed their own operational definitions of ZPD, but all can be summed up in Tzuriel's (2000) definition which states that ZPD is the difference between actual development and potential development. Actual development describes the student's level of higher order thinking and problem solving compared to potential development which is determined by their level of problem solving under the guidance of an adult or in collaboration with a knowledgeable peer (Tzuriel, 2000). An overarching principle of ZPD is, when applied appropriately, students should be able to do independently today what required assistance yesterday (Lerman, 2001). Lillie Albert (2000) stated this principle more eloquently in her research on the thought processes of seventh grade math students by observing that students gain independence in their ability to complete tasks on a somewhat daily basis.

Additionally, one's ZPD is inseparable from their development, both intellectual and affective. The ZPD method emerged in Vygotsky's research in part as a response to the need to include sociocultural understandings in learning potential and cognitive development (Tzuriel, 2000). As seen previously, learning occurs first on the social plane and is then internalized to the individual plane. Thus one can deduce from these findings that the emotional maturity needed to participate in social interactions is needed in order to gain intellectual understandings and vice versa (Eun, 2010). The interaction of both of these areas of development is needed to propel the student further on her road to maturity and independence. With respect to teacher planning, the ZPD method is also future oriented, continually planning for tomorrow's lessons and activities. It uses the student's educational and developmental past and present as a guide to their developmental future (Levykh, 2008). A teacher would plan lessons that speak to the student's next phase of development or on concepts just outside of the student's current level of understanding, thereby propelling the student forward.

Use of the zone of proximal development in the classroom allows educators to identify what functions the student has developed and determine which are still in the process of developing (Levykh, 2008). Pre-tests are a widely used educational tool to determine student readiness prior to introducing a new unit of study and have the same benefit here in determining a student's ZPD. A pre-test, series of pre-tests, or similar observational tool provide a concrete beginning to using this symbolical zone. After gaining insight as to where the student stands, the teacher is then able to provide the student with accurate information to assimilate into her consciousness and understanding, which moves the student along in her ZPD (Steele, 2001). This implies the two-way directional observed in Steele's 2001 study of a fourth grade math class. The teacher determines each student's level of knowledge and then teaches to that level

while students assimilate teacher guidance into their current thinking and skill set (Goos, Galbraith, & Renshaw, 2002).

ZPD is closely related to another commonly used teaching tool, namely scaffolding. Scaffolding refers to the mutual adjustment and appropriation of ideas rather than a simple transfer of information and/or skills from teacher to learner (Goos et al., 2002). By definition, scaffolding is focused more on past and current knowledge and using this information to bridge to new content, or a "past focus", whereas ZPD has a future focus as described previously. However the most significant difference between the two instructional tools is the nature of the teacher-student relationship while utilizing ZPD. Through classroom actions and activities and due to the heavy collaborative nature of ZPD, both students and their teacher can be pulled into their respective ZPD's (Lerman, 2001). This is an exciting aspect of the reciprocal essence of the zone of proximal development. In contrast, scaffolding only focuses on the student and provides only what is needed to bridge the gap between concepts. Scaffolding is a wonderful instructional tool and teachers are advised to use it when introducing new concepts and vocabulary. The tool fulfills its purpose when applied appropriately, but it is not the only tool teachers ought to use.

There are additional benefits of utilizing the ZPD in mathematics classes specifically. They include building mathematical language and problem solving skills. In 2000, Lillie Albert studied the effects of journaling and independent writing in seventh grade mathematics class. She found a significant improvement in the level and quality of mathematical understanding and problem solving skills when students first discussed new concepts as a class, then wrote independently about their ideas, and finally shared their thoughts in small groups. By using the ZPD in a similar way, a teacher first uses common language during the discussion to scaffold

mathematical language and then encourages the use of mathematical language in the students' individual writings (Steele, 2001). Problem solving skills are strengthened during the writing and sharing processes because writing allows students to participate in self-talk while sharing ideas which forces students to justify their actions and evaluate their progress.

Using Communication and Collaboration in ZPD

In sociocultural theory, communication is central to learning (Steele, 2001). By discussing topics with students instead of lecturing about a topic, the students are able to form their own meanings and discover their own understandings. This is applicable within peer groups as well. Recall from the previous section that collaboration within the ZPD can occur between teacher and student, teacher and whole class, or student and knowledgeable peer. In fact, peer collaboration can foster self-esteem, pro-social behavior, and scholastic advancement by allowing the free exchange of ideas and reciprocal feedback amongst equals on the same topic (Lau et al., 2009). This equal playing field has a dramatic effect on students because it allows each student to feel as though they have something to offer to the discussion. The highest quality of learning takes place when there is still something left for the student to discover; therefore, it is best to form peers groups where students have incomplete but relatively equal levels of expertise (Goos et al., 2002). In reality, students care more about what their peers have to say then their teachers. Using peer collaboration allows a healthy outlet for socialization and building communication skills. Such interactions produce cultural understandings of topics such as gender roles, ethnic stereotypes, body shape and size images, discovering abilities valued by peers, and social relationships are discussed sometimes without even being conscious of it (Lerman, 2001). Students can and should use their peers as tools for their own development so that they can identify with adults on a higher level, which promotes deeper conversations, thus

propelling the students' own development (Kravtsova, 2009). Thus, using peer groups benefits the learner on many levels, all of which lead to further development and self-reliance.

In addition to its social benefits, collaboration is also a useful mental tool for organizing one's thoughts (Albert, 2000). When students have to share their ideas aloud, they may take additional time and care to think through a topic which can lead to more depth and breadth in a conversation and/or discussion. As Steele (2001) observed, explaining their ideas to classmates helps both parties gain experience in justification all while deepening their own understanding of the topic. To justify, debate, and argue are all higher order thought processes (Anderson & Krathwohl, 2001). Informal class discussions utilize these top tier processes in such a way that allows students to practice in a low pressure environment, scrutinizing each other's thoughts and learning to accept other viewpoints.

Communication and collaboration not only aid in the development of higher order thoughts and functions, but they also help develop and enhance problem solving skills, especially in mathematics (Steele, 2001). The current trend in math curriculum is towards problem solving, mathematical reasoning, and communication (Goos et al., 2002), all of which can be attained using each student's ZPD and collaboration as a primary tool. Goos et al. (2002) describes mathematical problem solving to be multi-phase. First, a course of action is planned and then strategies are selected that fit the plan. Progress is continually monitored as the results are assessed. Finally, depending on the results, the plans and strategies are revised as necessary. Assisting students in flowing through this process and hopefully internalizing it allows teachers to assess the student's current level of problem solving ability within their ZPD, providing a great starting point for instruction (Levykh, 2008).

Effective communication is assessed according to a set of expected characteristics, per Goos et al. 2002 research on socially mediated metacognition in small group problem solving. For effective communication and problem solving to occur, participants should have a shared activity with a common goal, continuous communication, co-construction of understanding, methods to evaluate their progress, all under equal or mostly equal levels of expertise, as previously mentioned. It is inevitable that some students will struggle at first with the tools used within sociocultural theory. Specifically, students from culturally and linguistically diverse backgrounds may be at a disadvantage due to the ZPD's heavy reliance on the use of language as an instructional tool (Westby & Torres- Velásquez, 2000). This can be overcome when using peer groups by assigning roles for each student within the group. Using assigned roles levels the playing field even further, which English Language Learners (ELL) and students categorized under English as a Second Language (ESL) will especially appreciate (Cohen, Lotan, Scarloss, & Arellano, 1999). If students are willing and encouraged to actively participate in collaboration by sharing their thoughts and ideas, and also willing to listen to the solutions offered by others, they will experience an exciting growth opportunity through reflecting on their ideas and assimilating new ones (Lau et al., 2009).

Conclusion

The sociocultural theory of development paired with research based educational practices offers a wealth of resources for teachers who want to reach each student and encourage growth. In collaborating with peers and classmates, students are able to gauge their current level of understanding while safely exploring unfamiliar topics. A teacher who plans to use the ZPD to her class's benefit will be able to identify this region of unfamiliarity and provide a foundation with which the student's ideas can grow and develop into mastery, independent of additional

teacher assistance (Albert, 2000). The identification of and instructional processes within the ZPD are intertwined and constantly evolve with each student. By learning to detect the tiniest manifestation of initiative in each child and supporting, prolonging, and sustaining this initiative and coming to the child's aid at the precisely appropriate moment, self-reliance can be encouraged and established within each individual (Zuckerman, 2007). This detection process eases and becomes second nature with practice. It is also easier for teachers to assess the subtleties of change within each student's ZPD when the teacher has an in-depth understanding of the subject they teach. Professional development can help develop these understanding within teachers while other aspects will come with experience within the field. It is important when utilizing the ZPD method for teacher's lessons and activities to be planned, but not scripted. Allowing students to explore, reflect, and communicate their ideas while building connections between their personal language and formal mathematical language with fluid movement between the concrete and the conceptual (Steele, 2001). Most importantly, with the help of an adult, children have the infinite potential to learn anything (Eun, 2010). By using these concepts within the sociocultural theory, teachers will be able to handle and overcome the daunting task of differentiating within inclusive classrooms with confidence and ease while contributing to the healthy development of the next generation.

Application

The application section is intended for use in middle school mathematics courses. However, many of the strategies can be generalized for any grade level or subject matter. The materials include a model for creating lesson plans that utilize the ZPD of each student as well as example lessons, activities, and assessments. Resources to use as a means of identifying

students' ZPD are also included. To meet the needs of all students and encourage a well-developed outlook, cross-content collaboration is strongly encouraged.

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Appendix

Table of contents

The Collaborative Classroom

Fostering collaboration within the classroom can have several interconnected pieces. First, the students must know how best to work in groups, meaning how to behave and communicate effectively. Secondly, the teacher must have a way to monitor group and individual progress. Lastly, the classroom must be set up in a way that supports group work while not hindering individual work.

This section focuses on how to establish a set of classroom rules, teach students to work in groups effectively, and an example layout of a classroom. This section also includes a lesson plan template for implementing group work and collaboration. The sections that follow will include how to monitor student progress in groups and individually.

Classroom rules help insure that the class will not lead to otter chaos. While the Principal or school district may have rules they expect the students to follow, each teacher should have a set specific to their instructional style and anticipated classroom culture. Rules are best established with student collaboration and whole class participation. This way, students will have more ownership of the rules and therefore be more inclined to follow them.

Consider following these steps when creating a set of classroom rules:

1. Review the goals – Why is each student taking this course? What does each student hope to get out of the semester? Make it clear that to reach these goals the whole class must work together to create the best possible environment for learning.
2. Brainstorm possible disruptive behavior – What are some ways a classmate could disrupt the class or your thinking and learning? How could we be distracted from our goals? Keep a list of all the disruptive behaviors the students come up with. If they do not think to mention things like interrupting, bullying, or disrespecting the teacher, then the teacher ought to bring them up.
3. How to avoid disruptive behavior – Address each example provided on disruptive behavior and discuss ways to avoid them. Use their ideas to start creating the rules. When writing out the rules, it is best to phrase them in an affirmative manor that describes what the students should do and avoids stating what they should not do.
4. Consequences – Allow students the opportunity to come up with possible consequences for breaking the rules, but it is likely that they will need guidance. During this phase, establish rewards for following the rules as well. It is important to note that the

consequences should not be considered punishments. Instead, consider elements of positive reinforcement.

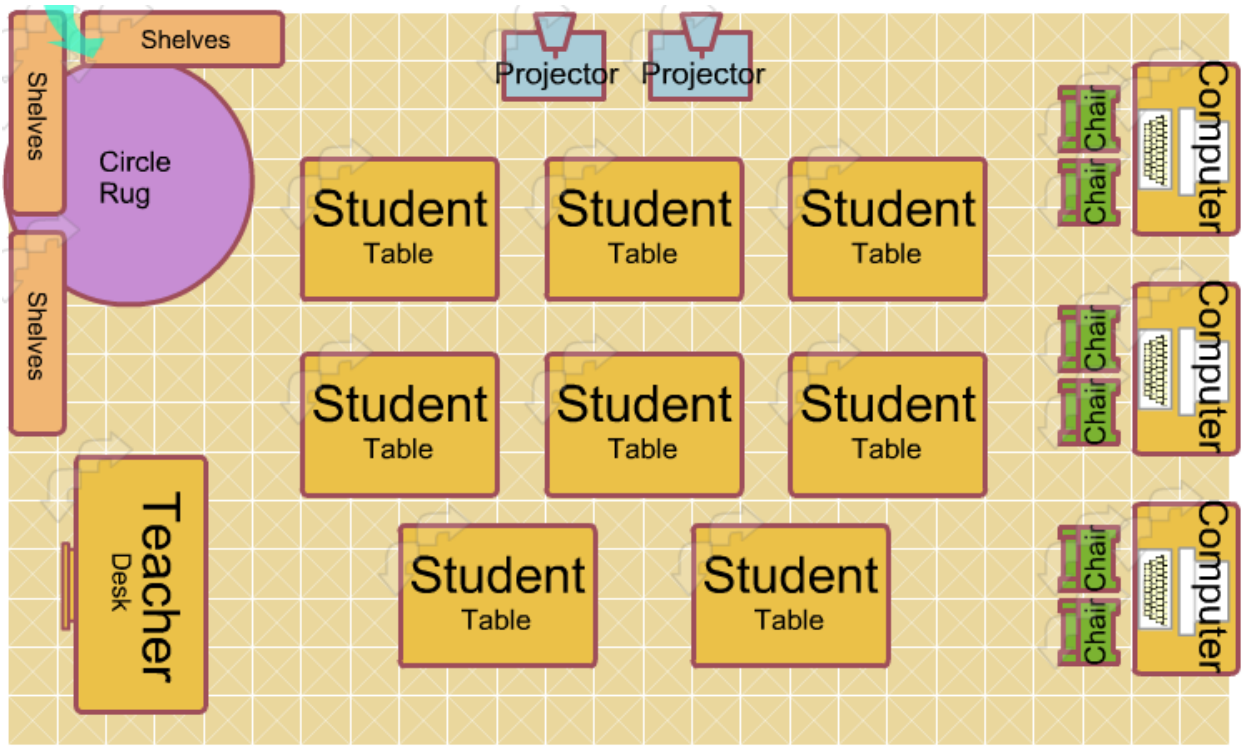
After the rules are established, have the students create a poster to display in the room. This provides another way of developing a sense of ownership over how the classroom will be run.

Working in groups requires another set of rules or standards, as well as establishing the norms within a group. Establishing norms or norming within a group basically sets the stage for a positive group experience. Norms are the baseline of expected behavior with rules such as listening to others and do not talk while another classmate is talking. Creating the group norms can be a collaborative process as well by following the same steps outlined for creating classroom rules. The class could even be broken up into small groups to brainstorm about possible norms, than come back as a class to discuss.

Another useful tool when working in groups is assigning each member a role. Elizabeth Cohen and Rachel Lotan with their colleges at Stanford University created a model for group work called Complex Instruction (CI). CI focuses on equal participation within a group while playing to each students' strengths. Within the model, the teacher creates groups of four to five students and assigns each of them a role. Assigning the roles will become less necessary as students get used to the responsibilities of each role and want to try out all of them. Students should collaborate with the teacher on the names of the roles, but the responsibilities should be consistent.

- Facilitator – asks if everyone understands what's been said, if anyone has a question, and keeps the group on task.
- Team Captain – reminds people of how they are supposed to proceed, makes sure everyone's ideas are heard, and ensures participation and civility; AKA Harmonizer
- Resource Manager – makes sure all conversations happen in the middle of the table, collects materials from the teacher, calls the teacher over when the whole group has a question, and returns materials.
- Recorder – takes notes on the ideas, questions, and hypotheses, prepares the group's presentation or paper, and makes sure everyone is confident in and can explain the group's solution.

Classroom layout. How the class is arranged can have a large impact on the quantity and quality of collaborative opportunities. By grouping students at tables instead of desks, students are able to get comfortable with their neighboring classmates leading them to be more inclined to discuss their ideas.



Created with Classroom Architect at http://classroom.4teachers.org/

4-Phase lesson plan template

To foster collaboration in the classroom, it is best to design lessons that call specifically for collaborative work. Following this template, presented by Lau, Singh, & Hwa (2009), will encourage students to share their current understanding of the subject and identify learning interests all while establishing motivation for the activity.

- Whole class discussion: teacher facilitates student understanding of a topic and determines strategies of presentation. Traditionally this would be the lecture portion of the class.
- Group work: students solve problems themselves through active discussion. Students assign themselves roles and discuss the proposed topic in detail, recording any remaining questions.
- Reporting back: students explain and justify their solutions to the whole class. A Jigsaw grouping could be used instead of reporting back to the whole class, depending on allotted time and class needs.
- Summing up: teacher sums up the lesson by actively discussing all solutions, justifying the legitimacy of each solution, introducing new symbols and mathematical language, and extending the problem.

Pretests

Pretests are given before a unit or lesson to see what each student already knows. They can be administered formally or informally. It is helpful and saves time to give a pretest on a Friday so that the new unit or lesson can begin on Monday. This allows the teacher time to review each students' responses and modify her instruction accordingly. Pretests also provide teachers with a baseline of student knowledge to use as a comparison with the unit's final assessment, offering a gage of total understanding. In addition to providing the teacher with necessary information about each student, pretests also give students a preview of what will be expected of them and help them focus in on the important concepts of the unit or lesson.

The following section contains pretests in various formats to use as templates for any VA SOL in middle school mathematics.

Formal Example for VA SOL 7.16

For each property listed below, write in the equation that describes it:

$24 + (-5) = (-5) + 24$	$9 + (-9) = 0$	$3(-5 \cdot 8) = (3 \cdot -5) \cdot 8$
$56 + 0 = 56$	$22 \cdot 0 = 0$	$-72(1) = -72$

1. Commutative property of addition: _____
2. Associative property of multiplication: _____
3. Additive identity property: _____
4. Multiplicative identity property: _____
5. Additive inverse property: _____
6. Multiplicative property of zero: _____

Describe, in your own words, how to determine the inverse of a fraction:

_____

_____

Now, try to re-write your previous sentence using your mathematical vocabulary:

_____

_____

Do you think it's possible to have an inverse of a whole number? Please explain your reasoning.

_____

_____

What do you think would happen if a number was multiplied by zero?

_____

_____

KWL charts are very versatile and can be used with any subject. This exercise can be done as a class, in small groups, or individually. The students are presented a topic and write down what they already know about said topic, some things they would like to know, and at the end of the lesson they list what they have learned. The first two columns would be used as the pretest and the last column saved until the end of the lesson or unit to gage comprehension.

Name: _____ Date: _____

Topic: _____

What I Know	What I Want to Know	What I have Learned

Exit Slips are used after a lesson as an informal assessment of student understanding. They can take on many formats. The two presented here are in the 3 – 2 – 1 format and also a journal entry.

Name: _____ Date:_____

Exit Slip	
3	Things I Learned Today… 1. 2. 3.
2	Things I found Interesting… 1. 2.
1	Question I Still Have… 1.

Journal prompts:

- Was this hard or easy? Why?
- How many times did you try to solve the problem? How did you finally solve it?
- Write 4 steps for somebody else use when solving this type of problem.
- Were you frustrated with this problem? Why or why not?
- Tips I would give a friend to solve this problem are …

Online math games: These games are fun for students and can be used as pretests. Depending on the site, each student will need to record their scores or the teacher can set up an account that will record student scores.

Review:

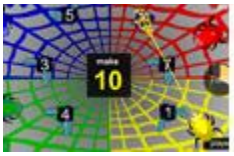
Tug Team Tractor Multiplication is a multi-player tug game with multiplication. Teams play together to pull the other team across the bouey. Each correct answer gives the team a tug. The team that pulls the other team over the bouey wins! Up to eight students can play at once. http://www.arcademicskillbuilders.com/games/tractor-multiplication/tractor-multiplication.html

Drag Race Division is a multi-player racing game that allows students from anywhere in the world to race one another while practicing their division facts. Each correct answer gives a speed boost to the student's car. Whoever crosses the finish line first wins the race. Up to 4 players can play at once.
http://www.arcademicskillbuilders.com/games/drag_race/drag_race.html

Operations with Integers: VA SOL 6.3, 7.3-7.4

Orbit Integers is a multi-player racing game practicing integer addition. How quickly the student correctly answers the problem determines how fast the spaceship will go. Whoever reaches the finish line first wins the race. Up to 4 players can play at once.
http://www.arcademicskillbuilders.com/games/orbit-integers/orbit-integers.html

Integer Warp is a multi-player racing game for multiplying integers. How quickly the student correctly answers the problem determines how fast the spaceship will go. Whoever reaches the finish line first wins the race. Up to 4 players can play at once.
http://www.arcademicskillbuilders.com/games/integer-warp/integer-warp.html



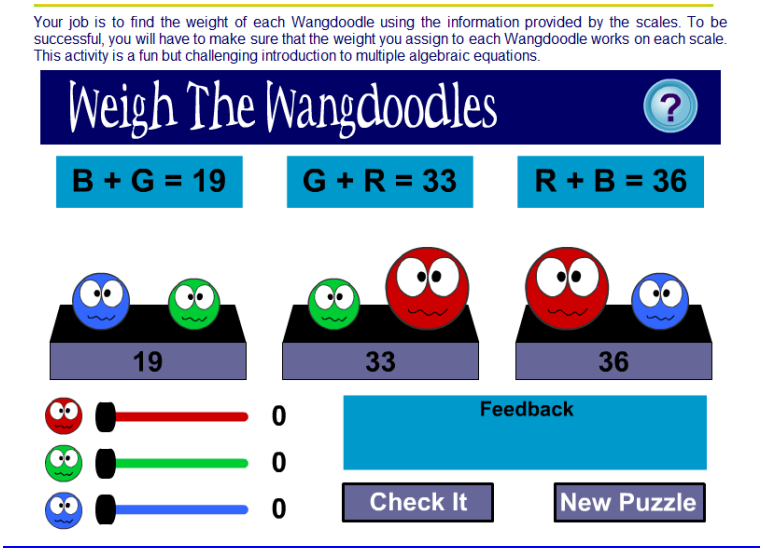
Spider Match is a multi-player combination game for adding integers. Students must grab flies that match the given problem. The student that correctly combines the most integers wins. Up to 4 players can play at once.
http://www.arcademicskillbuilders.com/games/spider-match/spider-match.html

Decimals and Ratios: VA SOL 6.2, 6.4, 6.6a

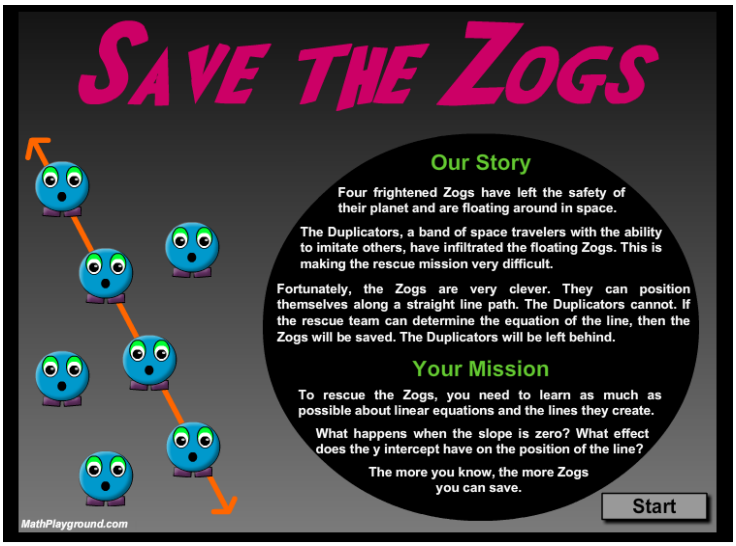
Tug Team Puppy Pull Decimals is a multi-player tug game for decimal words. Teams play

together to pull the other team across the marker. Each correct answer gives the team a tug. The team that pulls the other team over the marker wins. Up to eight students can play at once. http://www.arcademicskillbuilders.com/games/puppy-pull/puppy-pull.html

Algebra:



http://www.mathplayground.com/wangdoodles.html



http://www.mathplayground.com/SaveTheZogs/SaveTheZogs.html

These and many other games can be found at www.ArcademicSkillBuilders.com

Cognitive Maps and Graphic Organizers

Cognitive maps and graphic organizers are useful note taking tools that offer students a visual way to organize and categorize their thoughts. Teachers can have students fill in the graphic before, during, or after a lesson, depending on the graphic of choice. Students should store their graphics in their math notebooks to study later and so the teacher can check the graphics to gage understanding.

Cognitive maps and graphic organizers are primarily used in classes that emphasize reading, such as English, History, and Social Studies. However they can be very useful when presenting new information in mathematics and science classes as well. The following are examples of cognitive maps that can be used in any subject, but have been adapted for use in middle school math. The graphic will indicate whether it is best used before, during, or after a lesson.

Strategic reading and listening graphic organizers can be used throughout a lesson for students to think about what they know of a topic, what they think the presented concepts will help them do, provide a summary of the lesson, and finally state what they got out of the lesson and any remaining questions.

Name: _____ Date: _____

Topic: _____

<table>
<tr><td>Before Reading</td><td>Brainstorm</td><td>Predict</td></tr>
<tr><td>During Reading</td><td colspan="2">What's the Gist?</td></tr>
<tr><td>After Reading</td><td>Questions about main ideas</td><td>What I learned</td></tr>
</table>

Adapted from http://www.adlit.org/pdfs/strategy-library/csr.pdf

List-Group-Label graphic organizers, shown below, ought to be used to introduce new vocabulary and could be given to students as an SOL test study tool or at the beginning of a unit.

Name: _____ Date: _____

Topic: _____

In the first column, list all of the words you can think of that are related to the topic. Once you have created your list, group the words based on their similarities. Label each group when you are finished.

List	Group and Label

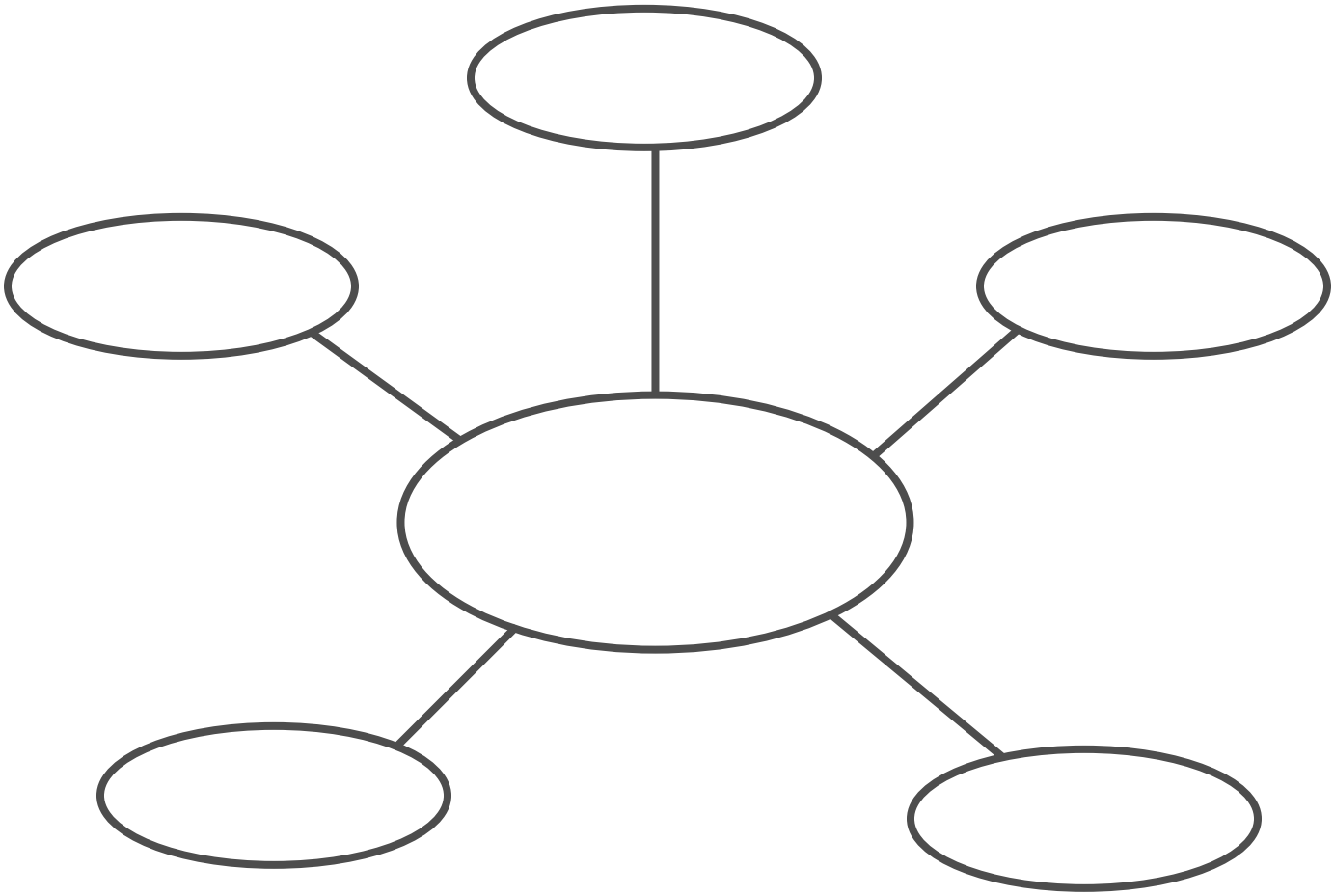
Adapted from http://www.adlit.org/pdfs/strategy-library/csr.pdf

Concept Maps can be used with any lesson and in any subject. They are a basic tool for students to use during a lesson to follow along with the teacher and take notes. The maps force students to discover the main idea and concepts discussed in the lesson. Again, the teacher can check the maps for student understanding.

Name: _____ Date: _____

Topic: _____

Use this map to organize your thoughts and make connections to your topic. Write the main idea in the center, and add supporting ideas or related topics in each surrounding oval. Continue to expand on your thoughts by adding more spokes to the map.



Jigsaw grouping is an impressive and multifaceted instructional tool that places students first in an Expert group and then in a Jigsaw group. While the whole class is focused on a topic, the Expert groups research and discover all they can about a subtopic, with each Expert group focusing on a different subtopic. Then, the Expert groups are mixed up to for the Jigsaw groups, each containing at least one Expert. Each student shares what they discovered with their newly formed Jigsaw group. This tool allows multiple subtopics to be covered in one class period while students are learning to be decisive in their research and participate in groups.

Name: _____ Date: _____

Main Topic: _____

As you read and discuss with your group, write down important facts about your topic. After you have become an expert on your own topic, you will share your findings with a group of classmates, and learn about their topics as well.

My Subtopic: _____

Important Ideas 1. 2. 3.
Summary
Other Facts

Adapted from http://www.adlit.org/pdfs/strategy-library/csr.pdf