PENNSTATE

Hands-On Manipulatives

The use of hands-on manipulatives is practically non-existent in college classrooms. For many tactile learners, the ability to 'feel' the theory or 'see' the abstract concept, there is an increased chance for understanding.

Hands-on manipulatives provide instructors a way to engage learners by giving students something that demands attention and interaction. There are a number of examples provided to engage learners of all ages.

Appropriate Student Level: Any Level
Suggested Class Size: 3 – 60
Ease of Use Rating: Moderate

Activity Description:

A hands-on manipulative can be described as "Any of various objects designed to be moved or arranged by hand as a means of developing motor skills or understanding abstractions."

These objects can be simple paper, paperclips, tape, glue, rubber bands, 'post-it notes' or string. The objects can also be purchased and be more specific to the discipline or task such as colored pipe cleaners, beads, blocks, tubes or cartons. All of these items are designed to be moved and shaped to meet the lesson objective.

"Landmark faculty have adapted or developed new ways to facilitate recognition and use of various sentence, paragraph, and discourse genre structures. These strategies are based on "alternative pathways," i.e., non-verbal channels, such as visual-spatial, kinesthetic, and tactile, which can be used to explain language structures and relationships among ideas. Teachers can use visual formats such as charts, diagrams, and concept maps; kinesthetic strategies such as walking stories; and tactile approaches such as using manipulatives to build models of structures and concepts. Manipulatives include Legos, Tinkertoys, and colored pipe cleaners, all of which have movable parts that can be linked together. Because many students are confused when language concepts are explained using only language, these approaches are powerful in general classrooms, as well as for students with language learning disabilities."

During a lesson on volume, small groups of students were given 2 sheets of large construction paper, glue, a ruler and a milk carton. The challenge was to build a container that would ship the 'most volume' for the fictitious customer. The project required hands-on manipulation of the tools, problem solving, mathematical concepts and group interaction.

"Hands-on" tactile learners or students with strengths in spatial thinking can capitalize on those pathways by building language models with manipulatives. For example, some Landmark College teachers use Cuisenaire rods to teach sentence structure explicitly in a multi-sensory, hands-on approach. This involves moving colored rods of different lengths into patterns that represent basic sentence structure. Unlike traditional sentence diagramming, building sentences involves touch, movement, and color, which may be critical features in particular students'

understanding of these patterns. It also reinforces the fundamental notion that sentences are made of interchangeable parts and that, although sentences follow predictable and recognizable structural patterns, those patterns can be used to generate infinite individual examples of sentences. These are abstract and difficult concepts that become self-evident when students experience sentences in three dimensions." (Olivier, Carolyn, et. al, 2000)

Students will benefit from building models with Legos, Tinkertoys, or other manipulative kits made of different colored and shaped parts. Colored paper strips or paper tubes may be used as well. First, students spend time thinking and talking about their topic. Next, they build a model that demonstrates how their various ideas relate to each other. Teachers or peers may ask students to talk about their models; students should describe their models, explaining what ideas are represented by each part, and how they connect to each other**.**

Manipulatives can be defined as any tactile learning tool used in teaching a new concept or reinforcing one already taught. An important component of the use of Manipulatives is the presentation of the goals and objectives. It is not enough for people to play around with things, there has to be a clear purpose for the use of the equipment.

Manipulatives may include:

Chemistry balls and sticks:

Colorful balls and sticks that can be formed into a variety of molecular models tohelp emphasize how compounds are constructed and/or destructed.

Charts and Diagrams:

Charts and diagrams have been used during lectures in thousands of classes. The instructor creates the chart and displays it on an overhead projector or at the front of the class and continues to talk for the remainder of the time, referring to the chart as a prop in the lecture. By changing this method only slightly, the chart can be come an interactive part of the lesson and increase students' collaboration and interest.

In order to activate a lesson using charts and diagrams:

- Allow students to work together to create a new chart or table for reference or further explanation of ideas and concepts presented in the lecture.
- Provide students with a chart and ask them to describe what they see, essentially, providing the students can provide the lecture with guidance from the instructor.
- Accept charts and diagrams in lieu of written words for some essay assignments.
- Use charts and diagrams as just one example of manipulatives used the classroom.

Walking stories:

The walking story gets it name from the walk it takes around the room. The story is started by someone in the class (or the instructor) and the story 'walks' around the room moving from person to person with each person contributing a sentence or paragraph. Some stipulations may be made at the start of the activity; for example, all the facts must be historically correct or scientifically proven. This sort of activity can help students to synthesize their knowledge and use it on the spot.

Walking stories may be a good introduction to a new area of history or literature. By using this method, students can show how much they know about a subject in an interesting way, sans the pen and pencil there are no papers to grade.

Lego:

LEGO® is a trademark of the LEGO Group of companies. There are a number of websites on-line that promote the use of Legos for teaching. This site http://live.edventures.com/x/wr/unitlist.html lists a large number of ideas for a variety of ages; many of the ideas can be adapted to a college classroom. There is also a challenge that the author can 'teach anything' using Legos.

For example: The instructor can initiate a class discussion describing how different gear combinations can be used to calculate math equations. The instructor can build an abacus out of LEGO® elements, and demonstrate its use to the class. The instructor should discuss several other famous mechanical calculating machines. For example:

- Pascaline's Digital Adding Machine.
- Gottfried Leibniz's "Hand Cranked Calculator."
- Charles Babbage's Difference Machine or Analytical Machine.
- Alan Turing's Turing Machine.
- Vannevar Bush's Differential Analyzer.
- Derrick Lehmer's Mathematical Sieve.

Students can then be challenged to build either an abacus or a unique mechanism that can do simple counting or addition and subtraction. These devices demonstrate "Calculating Machines of the new Millennium."

These kinds of problem-solving activity can reinforce the concepts introduced and allow students to see the value of simple machines.

Tinkertoys:

A stonemason named Charles Pajeau invented Tinker Toys in 1913. Inspired by the sight of children playing with sticks, pencils and spools of thread, he decided to build a playset for children that would incorporate these shapes. The heart of the set was a series of wooden spools that had eight holes on their perimeter and one larger hole through the middle. Also included were a series of cylinder-shaped wooden sticks that could be stuck into the holes of these spools to create all types of three-dimensional shapes and objects.

Several years ago when a student group from the Massachusetts Institute of Technology constructed a computer entirely (well, almost entirely) out of Tinkertoys! http://wwwrci.rutgers.edu/~cfs/472_html/Intro/TinkertoyComputer/TinkerToy.html

"Not all challenges are good. A challenge that doesn't permit students to judge for themselves whether they've succeeded in addressing it is, in my view, dumb. For example, if I challenge you to use a calculator to find the product of 37 and 563, that's

pointless. On the other hand, if I tell you to build a Tinkertoy bridge that can hold a dictionary, you don't need me to tell you when you've succeeded. You can test your results right away. An intelligent challenge permits you to judge whether or not you've met it." (Schwartz, 1992)

Colored pipe cleaners:

Pipe cleaners are typically made from a bendable wire covered in a fuzzy colored material. These fuzzy sticks can be shaped and molded into any number of shapes. The can be used for mapping, architecture, math, and in other creative ways. The wires can be used to make a construct, measure, denote distances or calculate area.

Pipe cleaners can be used in a science lesson to represent a neuron. By having students create the product there is interaction with the information, thus increasing the possibility of retention. This pipe cleaner neuron is made of 5 different colors: one color each for the dendrites, cell body, axon, myelin sheath and synaptic terminal. Any colors will do. (1) Take one pipe cleaner and roll it into a ball. This will be the cell body. (2) Take another pipe cleaner and attach it to the new "cell body" by pushing it through the ball so there are two halves sticking out. Take the two halves and twist them together into a single extension. This will be the axon. (3) Take other pipe cleaners and push them through the "cell body" on the side opposite the axon. These are dendrites. These can be shorter than your axon and you can twist more pipe cleaners to make more dendrites. (4) Wrap small individual pipe cleaners along the length of the axon. These will represent the myelin sheath. (5) Wrap another pipe cleaner on the end of the axon. This will be the synaptic terminal.

The main purpose of using this manipulative is to increase tactile learning by providing manipulatives that are pliable and useful. The challenge to a successful lesson using pipe-cleaners is focused on the objectives of the instruction and making the expectations clear to the students. A well-stated problem accompanied by corresponding manipulatives will help to increase student comprehension and aid in retention.

References:

Kull, Keith R. (1999) "A developmental education survey: Results of a national survey of program design and mathematics instruction", Education, 120(1), p. 69

Olivier, Carolyn; Hecker, Carolyn; Klucken, Joyce; Westby, Carol (2000) "Language: The embedded curriculum in postsecondary education", Topics in Language Disorders; 21(1) p. 15

Schwartz, Judah L. (1992) "Of Tinkertoys, Technology, and the Educational Encounter", TECHNOS Quarterly For Education and Technology, 1(2), http://www.technos.net/journal/volume1/2schwartz.htm

The Core Competencies are:

1. Writing, speaking and/or other forms of self-expression
2. Information gathering, such as the use of the library, computer/electronic resources, and experimentation or observation

3. Synthesis and analysis in problem solving and critical thinking, including, where appropriate, the application of reasoning and interpretive methods, and quantitative thinking
4. Collaborative learning and teamwork
6. Activities that promote the understanding of issues pertaining to social behavior, scholarly conduct, and community responsibility
7. A significant alternative competency for active learning designed for and appropriate to a specific course