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Engineering Technology K -8

Engineering Technology promotes and strengthens a range of learning skills that are already being promoted in every school's curriculum, so Engineering is a curriculum area that supports and enhances work being done in all other existing areas.

Skills such as cognitive thinking skills which include imaging, speculation, constructing and developing ideas, are already being taught and developed through many areas, including Language Arts. Communication skills are being enhanced in every area of the curriculum. Critical awareness and evaluation skills are some of the higher order skills that we teach and promote in the Intermediate grades along with reflection and self assessment. All these skills are essential for achieving good design engineering and they enhance the skill development in every other curriculum area

So how can we incorporate Engineering Technology into our present curriculum frameworks? First let's look at what it entails.

1. Identify a Need
2. Research
3. Develop and Communicate Ideas
4. Design Logistics
5. Build and Test
6. Evaluate

1. Identify a Need

Using the Engineering Design Process outlined in the Massachusetts Frameworks, *"..identifying a need"* is the fundamental design factor that starts all design processes. However, in the early stages, this can be a difficult concept for children. One of the ways to make it less daunting, for children and teachers, is to provide source materials that stimulate ideas and allow imaging.

An excellent source material, already a valued and integral part of every existing school curriculum, is literature. Stories work very well because they are a recognized source for stimulating creative ideas and challenging a child's imagination. They are a very effective medium for introducing design concepts to Elementary school children, especially in the Primary grades, since they can present situations and contexts which utilize and compliment children's real experiences of the world. This allows for the initial development of design ideas, within a framework, which then builds each child's skills and confidence to a level where they can move forward with less formal guidance.

In the lower grades teachers can use a range of stories, including traditional ones, to help the children think about systems, artifacts and environmental influences and thus promote the design process by posing questions such as:

"How could the three little pigs build a strong and secure house? "
(Identifying materials and ways of buildings: i.e. which other materials could the pigs have used which would have been as strong as bricks, or how could the building process alter the possible outcome? Look at the differences in strength between a Lego house built by placing one brick on top of each other or using overlapping bricks.)

"What system could you develop for helping Goldilocks escape safely from the bears' house? " **(Design a way of leaving the bedroom such as a slide or a trampoline)**

"Can you invent a machine that would pull up enormous turnips? "
(What would the machine look like and how would it work? Draw a picture or make a model of your invention).

"How could Jack get things down, safely, from the top of the beanstalk without carrying them? "
(Identify a system that would work for lowering things down. What size would it need to be? How would it work? What might it be made of?)
NB: Remember that these are all fairytales so the material may not be something that exists in today's world!

1. Research

An important component of any design process is research and this is an area that may be approached in a myriad of ways. For young children their "research" may be the introduction to many different books about a subject, the observation of a living or non-living item, or asking questions of their friends and family. For older children research may involve the use of the internet, related magazine articles and a range of books. It is often helpful to older children if they have a specific focus on a precise area for their research. This enables them to make better use of their time and allows them to be more successful in gleaning the information that they really need to inform their design. The research component is often involved before the communicating of an idea in order to develop the best possible solution, but it may be brought in later to inform and modify the initial idea.

This component involves many of the skills that are being taught in Language Arts, Science and Social Studies. As with other research areas, it is helpful to the children if a graphic organizer format can be used for Engineering Technology research.

3. Develop and Communicate Ideas

After identifying a need and carrying out research, we move on to developing and communicating ideas. ***This is a critical part of the design process.*** Communication covers a wide range of possibilities including pictorial representations, written reports, accurate engineering drawings and modeling. Successful communication occurs when a designer has managed to share an idea with others in such a way that they understand his design idea. Oral communication of ideas can be very difficult for young children and communicating a 'picture' in their head can be even more difficult. It is often important to allow children to try and create their initial prototype as a way of expressing their design idea. This gives the audience a better understanding of the design idea and also allows the child to reflect upon his/her initial design and maybe make early evaluations and adaptations.

Prototypes may be made from many things such as modeling clay, building bricks, junk materials and paper. Children should be encouraged to make the prototype in a similar shape to their idea without spending too much time on small details. The prototype will inform their original idea and allow them to see whether any major changes need to be made or just some adaptations.

4. Design Logistics

Once children can identify and communicate a need, they can start to think about the logistics of their design. Factors to be considered at this point would be things such as the materials available, types of fixings and fasteners and the tools required. (Strand 1 and 2 in the Mass. Frameworks - Materials and Tools). For the older grades there may also be the constraints of time and money parameters to consider. Once tools and materials have been identified the child should be able to communicate the order in which the work will be carried out. This can be shown in many ways such as a flow diagram, a written set of instructions or in pictures. The sequence should reflect everything that needs doing.

Materials and tools may be restricted by the availability in the classroom/school, or by the working knowledge that the children have about them. Therefore it is important for the children to be introduced to a wide a range of materials and tools so that they can make the most informed decisions possible when generating their design ideas. The strength of a child's design may be largely determined by

selecting appropriate tools and materials, which means that the children will certainly

need guidance and assistance with this process in the early stages. The logistics of a design are similar to the details on a story map, but instead of the 'who' and 'where' (characters and setting), they are looking at the 'what' and 'how'. The sequencing of the design making section can be likened to a story, thus enabling the children to see the importance of a correct order. The order of making a product should be outlined in words or pictures so that other people could reproduce the basics if necessary.

5. Build and Test

The next stage would be to build and test the design. If a prototype has not already been made it would take place now and would allow the children to receive immediate feedback about their initial evaluation of the design idea. The children may find they need to change the projected size or shape or re-evaluate the materials that will work best for their design idea. Upon testing the prototype the children may either proceed onto their full scale design or redesign part/all of it.

6. Evaluation

Evaluation is the cornerstone of all design processes and this is another time when the children need to be able to communicate their findings and subsequent ideas. Children should be encouraged to evaluate the product they produced, the work they did, and the effectiveness of their initial (or modified) design idea. They should be told that it is okay if their product fails to fulfill its initial criteria. Scientists and designers the world over generate some of the most important research material based on designs that fail.

An example of evaluation questions, posed by a child or teacher, might include some of the following:

Do you like the -way it looks and feels? Haw -well does it work? How does it work the way it does? Does it fulfill its purpose? Is it well made? Is it safe to use? Could it be used for anything else? Is it good value for money?

As a result of these questions a re-design may ensue or modifications may be suggested for future uses.

In my dealings with children I have found that many children have Design Ability (they can design) but most need teaching about Design Awareness (knowing how to design) in order to release the creativity that they have.

Diane M. Mason, June 2004