AN ELEMENTARY SCHOOL TECHNOLOGY EDUCATION CURRICULUM RESOURCE GUIDE

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FEATURE ARTICLE

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The summer of 2003 marked a major milestone in the field of children's engineering in the Commonwealth of Virginia and across the nation. *Children's Engineering: A Teacher Resource Guide for Design and Technology in Grades K-5*, a first-of-its kind document, made its debut. With this publication, teachers can nurture a classroom of children who are positively and energetically communicating, solving problems, thinking creatively, and practicing learned skills in controlled real-life situations.

Preparing the students of today to become productive citizens of the future requires our educational system to promote life-long learners who are able to work together to solve realistic problems and develop a basic understanding of the natural and humanly modified world around them. Information presented in a familiar and mind-engaging context leads to greater understanding and retention, as compared to memorization of facts in isolation. Research indicates that retention is greatest when students are actively engaged, put their knowledge into immediate practice, and become "teachers" of other students. Activities found in *Children's Engineering: A Teacher Resource Guide for Design and Technology in Grades K-5* directly address these issues.

The guide brings design and technology into the K-5 elementary classroom while directly supporting Virginia's challenging Standards of Learning. The design and technology process, children's engineering, integrates technology into the teacher's already established curriculum. It supplements, rather than replaces or adds to, the elementary educator's already full load. The purpose is to involve students in activities aimed at improving, using, and mastering their academic skills as well as developing their understanding and appreciation of technology. While academic skills mastery is the controlling ingredient in each project, the children acquire technological literacy as they are introduced to the world of technology defined as human innovation and invention.

A Sample Design Brief

A fourth grade design brief taken from the *Resource Guide* directs students to design and build a model trunk for transporting goods to the Jamestown Colony. Working together in groups of three or four, the students encounter many decision-making opportunities as they work to solve this historically real-life problem. They willingly apply research skills as they discover what the travelers of the seventeenth century would have taken with them as they departed for a new land. Through the brainstorming process, they discover that there is more than one way to solve the problem and still meet the stated criteria. Critical-thinking skills are employed as each group reaches a consensus on the "best way" to build the trunk.

Upon agreement on a final plan, tasks are allocated based on the strengths and learning modalities of each group member. The gifted, as well as the academically and physically challenged, have the opportunity to make positive contributions when completing the assignment. Notable increases in time on-task and attention span are evident, as students become active participants and, consequently, discipline problems often decrease. This type of "hands-on, minds-on" activity evens the playing field, allowing every class member to take pride in his or her unique contributions. Interaction between peers improves, as does respect for individual differences.

The fun begins as the students actually construct their trunk, experimenting with a variety of natural and man-made materials and employing the use of different tools, such as rulers, cutting utensils, drills, and computers. During the building phase, emphasis is placed on the process that is taking place rather than solely on the final product. Students are encouraged to profit from their mistakes, and it can be noted that temporary failures often lead to greater learning.

Curriculum integration is evident throughout the design and technology approach. At the onset of this fourth grade project, historical research is required for a basic understanding of seventeenth century life in Europe and America. Students must also apply previously learned mathematical skills as they construct a trunk that holds a volume greater than 36 cubic inches and less than 60 cubic inches, has edges that are parallel and perpendicular to other edges, and is wider than it is tall. Reading comprehension occurs throughout the experience as students must define the problem, conduct research, and record their findings. Writing, grammar, and spelling skills are emphasized as individual portfolios are completed. Students must also hone their formal oral presentation skills as they present their finished trunks to an audience. Herein lies an opportunity for higher level questioning such as: "Why did you choose this design?" or "How would you apply what you have learned from this experience if you were asked to build another trunk?"

Standards for Technological Literacy

In addition to supporting state and local academic standards, each activity included in the guide reinforces targeted goals from the *Standards for Technological Literacy: Content for the Study of Technology* document, which was published in 2000 by the International Technology Education Association and its Technology for All Americans Project. As students complete the trunk assignment, they begin to develop an understanding of the attributes of design, the application of the design process, and the roles of troubleshooting, experimentation, research and development, and invention and innovation in problem solving.

Inclusion of design and technology in the elementary classroom helps meet the cognitive, psychomotor, social, and emotional needs of all students. In the context of solving real-world problems through academic skill mastery, students become innovators and inventers, a.k.a., children engineers.

Assessment and Accountability

Individual accountability and assessment, along with group participation, are important components of the children's engineering approach. Each student keeps a portfolio recording his or her brainstorming ideas, research notes, questions, sketches, plans, picture of final product, testing results, evaluation, and ideas for improvement. This portfolio provides a comprehensive picture of the design process that has taken place as well as the finished product. Furthermore, ready-to-use rubrics are provided for teacher utilization. These methods of documentation provide the classroom teacher with a concrete basis for assessing mastery of academic objectives and reporting student progress/grades to parents and school administrators.

Guide Overview

The idea of creating a "user friendly" resource guide that would be widely accepted was embraced by the document writers. Four activities at each K-5 grade level were developed for the core curriculum areas—English, mathematics, science, and social science/history. Each activity focuses on one target Virginia Standard of Learning (SOL) and reinforces multiple SOLs. In addition, each activity reinforces *Standards for Technological Literacy*. Included in each of the 24 activities is a design brief, teacher tip page, guided portfolio, and rubric assessment. The complete guide can be viewed at www.pen.k12.va.us/VDOE/Instruction/CTE/te/k-5/Engineering/.

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