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AUTHOR	Kumar, David; Bristor, Valerie J.
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ABSTRACT

Technology can be utilized as a tool for creating macrocontexts for teaching integrated science and language arts. Teachers can use several criteria for deciding what kind of technology-based resources to use; the teacher's level of confidence in science and language arts content and knowledge of technology-based resources is vital to making such innovative curriculum decisions. The following steps can guide teachers: (1) the context chosen for integration must be available on videodisc, videotape, compact disc (CD), or the World Wide Web; (2) the context must be appropriate for student viewing at the elementary levels; (3) the context must be rich in information needed to gain the attention and interest of students; (4) the context must contain explicit information in a language of communication familiar to students; (5) the science and language arts represented in the context must fall within a topic of inquiry in the school science and language curricula; (6) the teacher should be able to clearly identify the science concepts and language skills to be taught embedded in the context; and (7) the topic must be appropriate to the level of the students. Examples of useful videotapes, videodiscs, CDs, and Web sites are included. (Contains 20 references.) (AEF)

Technology-Based Macrocontexts for Teaching Integrated Science and Language Arts

By:
David Kumar
Valerie J. Bristor

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David Kumar
Florida Atlantic University

Valerie J. Bristor
Florida Atlantic University

This paper describes technology as a tool for creating macrocontexts for teaching integrated science and language arts. Since both science and language arts involve interrelated cognitive functions, integrating the two subjects would be an interesting way of teaching in elementary education (Krogh, 1995; Koballa, Jr., 1991; Caine & Caine, 1991). From a synthesis of literature Koballa, Jr. (1991) summarized that teaching science improves reading skills, reading readiness, written and oral communication skills, and also the development of language in students with disabilities. However, a study by Eldridge, Jr. (1988) found that the emphasis on reading skills in science lessons remains very limited.

According to Yates and Chandler (1991) learning involves making conceptual changes in cognitive structure by placing new information in a mental network of prior information in a meaningful way. In order to achieve greater cognitive gain, learning must be meaningful. According to Ausubel's explanation of verbal learning (cited in Anderson & Pearson, 1984), learning becomes meaningful only when new ideas make relevant connections to known ideas already established in the cognitive structure of individuals. From this perspective the context of learning is critical, because knowledge is located (or situated) as a part of the context from which it is acquired (Brown, Collins, & Duguid, 1989).

Macrocontexts and Technology

Studies of contextualization by Brown, Palinscar, and Ambruster as well as Tharp (cited in Baker, & Brown, 1984) emphasized the importance of "essential strategies in the context of actually reading or studying with the goal of arriving at a coherent interpretation of the text" (p. 383). For example, integrating language arts with science provides those "essential strategies" in addition to augmenting the context of each content area. See Kumar and Voldrich (1994) for a report of literature-based macrocontexts for teaching science at the elementary grade level. Educational technology makes it possible to enrich contexts for the integration of science and language arts. Both science and language arts are areas which help students engage in learning cognitively. As discussed earlier in this paper, new information should be able to find a niche in the knowledge structure of the learner in order to be connected meaningfully to existing knowledge.

It should be pointed out that the kind of technology needed for the integration of science and language arts is not limited to specialized educational technology applications such as custom developed multimedia systems. In the age of information technology there are various resources such as videos and the World Wide Web (WWW) that can be used to create macrocontexts for teaching integrated science and language arts. Teachers can use several criteria for deciding what kind of technology-based resources to use for creating macrocontexts in teaching integrated science and language arts. It should be emphasized that the classroom teacher's level of confidence in science and language arts content and knowledge of technology-based resources are vital to making such innovative curriculum decisions. The following suggestions are a few steps that should guide teachers in this task:

1. The context chosen for integration must be available on videodisc, videotape, CD or World Wide Web (WWW).
2. The context must be appropriate for student viewing at the elementary levels.
3. The context must be rich in information needed to gain the attention and interest of students.
4. The context must contain explicit information in a language of communication familiar to students.
5. The science and language arts represented in the context must fall within a topic of inquiry in the school science and language curricula.
6. The teacher should be able to clearly identify the science concepts and language skills to be taught embedded in the context
7. The topic must be appropriate to the level of the students.

Applications

Videotapes. Reading Rainbow series is an excellent program on videotape that can be used to create macrocontexts for teaching integrated science and language arts. The episode "Hill of Fire" (Liggett, 1985) was used in a fourth-grade Drop Out Prevention research project (Bristor, 1994; Bristor & Drake, 1994). After reading the text concerning volcanoes in their science books, the fourth graders watched the Reading Rainbow "Hill of Fire" segment. The following discussion included comparing the Kilauea Volcano in Hawaii to the Mexico volcano in "Hill of Fire" and comparing the science text with the graphic model in Reading Rainbow. Other activities could include the following (Schweiger, 1988): Ask students how can we learn more about the Paricutin Volcano, Kilauea Volcano, and other volcanoes; Ask students to identify what new information was in the program (Fumaroles, kinds of lava—aa and pahoehoe); Have students explore careers involving scientists who study volcanoes (Volcanologist) and instruments used to measure the intensity of volcanic eruption (Seismograph). Also, the fourth graders pretended to be on-the-scene reporters recounting the pertinent facts about the eruption. The students were delighted to hear that they would have the opportunity to read their news reports before a video camera. Even the children who were usually reluctant to write were excited about the assignment. One student combined his prior knowledge (facts concerning the event) as well as vocabulary words (such as "village," "abandoned," and "destroyed") learned from the video and book along with science concepts (how volcanoes are formed) from the science textbook to write the following "draft" of his news report.

On February 20th 1943 a farmer was plowing in Mexico. Then the plow got stuck in the earth [sic] crust and the earth began to shake. Then smoke came from the ground. A hill came up from the ground and shoting [sic] rocks from the ground. And the heat and the pressure formed a volcano. The volcano erupted and the volcano covered the village [sic] was destroyed. The people abanded [sic] their homes. No people were hurt but their homes were destroyed. Now 50 years later you can go see the volcano and the covered vilage [sic]" (Bristor, 1994, p. 35)

Other integrated science and language arts activities can include (Butzow & Butzow, 1989; Schweiger, 1988): Using the *World Almanac* find the list of active volcanoes in the world. Assign cooperative groups of students to investigate and research the different types of volcanoes from around the world, including information about how the volcanoes affect the people living nearby. Use pushpins or sticky dots to indicate the volcanoes' locations on a world map. Why is this arrangement of these volcanoes often called the "Ring of Fire?" In what area of the world are most of these volcanoes located? Have children create their own exploding volcano by using plaster and water according to package directions. Baking soda in the "crater" with a few drops of vinegar produces an "eruption"; Have children collect rocks and stones that can be used to create a stone sculpture; and Have children read fiction and nonfiction trade books related to the topic of volcanoes.

Videodiscs and CDs. Videodiscs and CD's serve as anchors for providing macrocontexts in which the learner can further explore learning across subject boundaries (Cognition and Technology Group at Vanderbilt, 1991; 1993). Take for example instruction using the *Raiders of the Lost Ark* videodisc described in the Cognition and Technology Group at Vanderbilt (1993). According to CTGV, students who participated in learning activities using this videodisc were successful in making spontaneous connections between classroom lessons and events or activities outside the classroom. That is, the videodisc anchor enabled students to "use standards (e.g., the height of Indiana Jones) to measure other objects (e.g., the width of the pit in the cave; the length of the airplane). They spontaneously attempted to use similar techniques to estimate the height of objects on the campus such as height of buildings, flagpoles and trees" (CTGV, 1993, p. 61). Such a popular movie should also lend itself to a variety of language activities including the comparison of spoken English among various cultures represented in the movie.

Another example of using videos for integrated instruction is found in the CTGV's (1993) report of the Young Sherlock project. In this project, the story of Sherlock Holmes was used to create a macrocontext for integrating language arts, scientific reasoning and history skills. According to CTGV (1993), "students discuss general principles for writing effective and coherent stories rather than focus only on the concrete story represented in the Young Sherlock video" (p. 56). Students were able to develop pattern recognition skills by noticing the wounds to the throat of the murder victims. In addition, they were able to transfer knowledge by applying vocabulary learned in the classroom to situations beyond the classroom and spontaneously create "coherent plot structures across multiple story writing activities" (p. 61).

The "Adventures of Jasper Woodbury" Series is another example of video-based integration. The Jasper Series (professionally made videodiscs of approximately 15 minutes in length) involves a series of adventures of a character named Jasper Woodbury. Each episode is embedded with data. The challenge to students is to understand the episodes and solve problems. For example, in a challenge involving a boat journey in the episode "Journey to Cedar Creek" students were to determine the speed of the boat. According to CTGV (1993), some teachers who used this episode in their classrooms "helped students construct and use charts that allowed them to determine how speeds defined as 'minutes to go one mile' translate into speed defined as 'miles per hour' (p. 55). This episode also provides visual clues for students to engage in writing activities describing a variety of characters, objects and places in the episode.

Additionally, students can explore related topics such as endangered species or principles of flight. Students can write their own adventure story using the information in the embedded teaching episodes. For example, one embedded teaching episode contains information on how to use a compass and bearing guide, how to read a topographical map, and how to use the properties of an isosceles right triangle to estimate heights and widths. Students could incorporate this information into their stories. A discussion of the similarities and differences between the two adventures on a major topic will help students focus on general characteristics rather than specific details. After the solution is shown, students could compare their solutions with the ones on the video and evaluate the strengths and weaknesses of each approach. To assist community members in understanding what it is like to solve the kinds of complex problems that the students are working on, community leaders and parents could be invited to watch a Jasper adventure and accompany students on a field trip related to that topic within the community.

World Wide Web. Since the advent of the World Wide Web (WWW) the availability of curricular materials in science has exponentially increased. The WWW is perhaps the most reforming factor to happen to science education since the curriculum reform efforts of the late fifties and early sixties. There are a number of science education web sites suitable for integrating science and language arts. An example of a web site suitable for integrating science and language arts is the *Science Power 2000* (SP2000). The SP2000 web site provides a series of interesting science lesson plans on topics such as birds, blue sky, clouds, energy flow, solid waste, etc. This web site is not only a source for hands-on instructional activities but also a platform for teaching whole language approaches to reading. Other WWW resources that are suitable for textual as well as science curricular materials include the Cable News Network's (CNN) *Sci-Tech Main Page* which provides macrocontexts for engaging students in Science-Technology-Society approaches to learning and problem solving in science around real world issues and also provides opportunities for developing skills in reading and oral communication. There are other WWW science resources on the Internet. Using a "Search Engine" locating WWW resources suitable for teaching science that are also suitable for language arts should not be a difficult task for teachers. However, it is strongly recommend that teachers adhere to some guidelines similar to the "Resource Selection Guidelines for Integration" listed earlier in this paper.

Assessment and Conclusion

Assessment of integrated science and language arts learning situated in technology-based macrocontexts is an important task. Teachers should not rely solely on traditional memory recall and short-answer tests insensitive to contexts (McColskey & O'Sullivan, 1993; Wiggins, 1993). In context specific situations "what is wanted is a more robust and authentic construct of understanding" (Wiggins, 1993, p. 209). Students loose their "natural enthusiasm" for learning once they notice that the ultimate purpose of the macrocontext based integrated activity is to prepare them for another paper and pencil test to earn a grade. According to Krogh (1995) and Kumar and Voldrich (1994), teachers should plan for a variety of alternative ways to assess students' performance in integrated instructional situations. The alternative assessment may include formal and informal observations, anecdotal records, portfolios, and follow-up activities. Students should not be assessed for their mastery of technology use.

Technology offers great hope for integrated science and language arts instruction. As in any technology-based instructional situation, technological applications for creating macrocontexts must be justifiable based on the foundational theories and principles of education or they will not stand the test of time in education. It is hoped that teacher education programs will incorporate technology-based approaches to creating macrocontexts for teaching integrated science and language arts in their preservice and inservice programs.

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David Kumar is Associate Professor in the College of Education, Florida Atlantic University, 2912 College Avenue, Davie, Florida 33314. Voice: 954 236 1025, fax: 954 236 1050.

Valerie Bristor is Chair of Department of Teacher Education and Associate Professor in the College of Education, Florida Atlantic University, 2912 College Avenue, Davie, Florida 33314. Voice: 954 236 1025, fax: 954 236 1050.

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