CENTER FOR YOUTH DEVELOPMENT

RESEARCH You May Have Missed

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RESEARCH YOU MAY HAVE MISSED . . . provides brief summaries of recent research relevant to youth development practice. It is designed to help youth development professionals keep up-to-date with contemporary research.

Editor's Note: These articles describe recent research in science education. Topics include teaching methods and pedagogy, developing an interest in science and collaborative work in science.

- Chin, C. (2007).
Teacher questioning in science classrooms: Approaches that stimulate productive thinking.
Journal of Research in Science Teaching, 44(6), 815-843.

This article describes an investigation into modes of teacher inquiry in the science classroom that act as effective scaffolds for productive thinking. Drawing from a social constructivist theoretical framework, the author analyzes meaning-making as a part of the teacher-student interaction, especially in the context of questioning. The author describes teacher questions as a type of classroom discourse. Teacher questioning can be analyzed for context of the question, content of the question, and response to the question. In the literature review the author describes differences between traditional and constructivist modes of teacher inquiry. Six science teachers from four schools, with an average class size of 40 students per class, participated in this study. 36 science lessons were videotaped and discourses were analyzed, focusing on teacher-student interactions where teacher inquiry prompted thoughtful responses on the part of students, or helped students advance in their thinking. The following four types of questioning emerged from the data: i) Socratic – use a series of questions to prompt and guide the students' thinking, ii) Verbal jigsaw – focus on the use of scientific terminology, keywords or phrases to form integrated propositional statements, iii) Semantic tapestry – help students weave disparate ideas together into a conceptual framework like a tapestry of ideas, and iv) use questions to frame a problem, issue or topic and to structure the discussion that ensues. Qualitative excerpts from teacher-student interactions that illustrate each of these themes are provided. The article also includes a chart that summarizes the context in which each of these types of questioning are useful. The author discusses the findings with regard to the contribution the research makes to understanding classroom discourses that stimulate and support students' thinking and learning. ***-AS***

- Grindstaff, K., & Richmond, G. (2008).
Learners' perceptions of the role of peers in a research experience: Implications for the apprenticeship process, scientific inquiry, and collaborative work.
Journal of Research in Science Teaching, 45(2), 251-271.

Recent science education has shifted in emphasis from framing scientific knowledge as facts, definitions, and procedures, to teaching for deep scientific understanding. The shift to engaging students in inquiry as means for developing deep understanding of the concepts has led researchers to examine how the understanding of the nature of science is enhanced by engaging students in opportunities to develop inquiry skills such as hypothesizing and using evidence to formulate explanations and justify a scientific argument. One aspect in understanding the development of the nature of science, is the role of peer interaction in science and science-based research activity. The present study included four pairs of high school students involved in a 7-week national research apprenticeship program. Students were interviewed about their perceptions of the experiences, surveyed pre- and post-program, and kept journals in which they recorded their thoughts about working with a research partner and the project itself. Data analysis revealed that students reflected benefitting, in varying degrees, in three different types of support from working on a science project with another peer. Social-emotional support refers to having someone your age to talk and socialize with. Social-technical support results from having common technical tasks to perform and students helping each other with learning these tasks. Social-cognitive support results from peer interaction that contributes to understanding the science such as how to interpret data. The authors were particularly interested to learn what contributes to the presence of social-cognitive support and what contributes to its absence. The teens had varied experiences in research and collaborative project work, and the project revealed that students who are open to multiple perspectives and open to the role of creativity and uncertainty are likely to have a richer picture of science in the making. For science educators to encourage deep understanding of science through inquiry, science must be more authentic and encourage learners to bring their own strengths to the tasks so that learning can occur through co-participation. This study highlights the importance of educators encouraging tasks that generate constructive possibilities of group work and take advantage of more minds, ideas and experiences to draw from. ***-RC***

- Khishfe, R. (2008).
  The development of seventh graders' views of nature of science.
  Journal of Research in Science Teaching, 45(4), 470-496.

A major goal of recent reform movements in science education is to help students achieve scientific literacy by helping them understand nature of science (NOS). Researchers of science education have proposed some general characteristics or aspects of how scientific knowledge is developed. These aspects include understanding that scientific knowledge is tentative (i.e., subject to change); empirically based (based on and/or derived from observations of natural world); subjective (influenced by scientists' background and experiences); partly a product of human imagination and creativity (involves invention of explanations); and socially and culturally embedded. Additional aspects are the distinctions between observations and inferences, and the relationships between scientific theories and laws. The present study examined the development of 18 seventh-grade students' views of NOS while they participated in a 12-week study of the structure and function of living things and a unit on populations and ecosystems. Over the 12 weeks, students engaged in three inquiry-oriented activities (taught by an experienced middle school science teacher with an informed view of NOS) that addressed the targeted science content and which allowed students to engage in a problem-solving situation. All students were asked to complete an open-ended questionnaire at the beginning of the study; semi-structured interviews were taken with six randomly selected students at the start, middle and end of the study. Results indicated that students' NOS developed over time, with more naïve views at the beginning progressing to more informed views of the four NOS aspects (tentative, empirical, inferential, and creative) targeted for this study. This study contributes to an understanding of the process involved in the development of students' views of NOS from naïve to more informed. ***-RC***

- Logan, M., & Skamp, K. (2008).
  Engaging students in science across the primary secondary interface: Listening to the students' voice.
  Research in Science Education, 38(4), 501-527.

Students' interest in science tends to decline from the primary to the secondary grades, and their attitudes toward science become less positive. Reasons for this negative trend are unclear. This study uses a longitudinal approach to follow 20 students over 2 years (sixth and seventh grades) to examine factors affecting students' attitudes and interest over time. By the end of the first year, the students were quite interested in science topics, particularly environmental issues, health, and space exploration. In general, the trend in their interest remained fairly flat over the time period of the study. Students reported being especially interested when science activities were practical and hands-on. One student commented, “If you see it you understand more.” Reasons why students’ interest declined included disliking writing and copying notes related to science, and not being able to carry out experiments on their own. In addition, having specialized equipment available for the lessons, such as Bunsen burners and microscopes, increased students’ interest level. Teaching quality also played a significant role in students’ attitudes, as did the ability for students to choose their own topics on which to focus and the ability for students to discuss and argue about the results they found. These results provide further support for an experiential learning approach toward science. ***-KH***

- Parsons, E.C. (2008).
  Learning contexts, Black Cultural Ethos and the science achievement of African-American students in an urban middle school.
  Journal of Research in Science Teaching. 45(6), 665-683.

In this article the researcher demonstrates the value of incorporating culturally sensitive instructional techniques through encouraging an active participatory mode and Black Cultural Ethos for African American students learning science. Black Cultural Ethos (BCE), a psychological construct (Boykin, 1986), encompasses the following nine dimensions: spirituality, affect, harmony, orality, social perspective of time, expressive individualism, verve, communalism, and rhythmic-movement expressiveness. Concepts from BCE require an active participatory mode of instruction where social interaction and physical movement are encouraged, in contrast to a passive-receptive mode of instruction where those are restricted. The goal of the study was to see if incorporating BCE into teachers’ mode of instruction in science lessons would be more effective for African American students’ learning than lessons that did not incorporate BCE. For the purpose of this study, the author chose three of the nine dimensions, social perspective of time or sociality, verve and rhythmic –movement. The study used a non-random controlled group design with three eight grade science classes, with 5, 10 and 8 African American students in each class, respectively, taught by two teachers, one European American and the other African American. The Caucasian teacher taught one science class and the African American teacher taught two of the classes. First the teachers’ natural instructional style was assessed to see how much BCE was incorporated. After conducting pretests, the African American science teacher was trained on an intervention to incorporate BCE into one of the two science classes that she taught. The BCE intervention included the following examples, i) encouraging social interaction rather than restricting (sociality), ii) having students take on multiple tasks that either occurred simultaneously or in sequence (verve), iii) designing lessons that required physical movement to complete tasks and allowing rhythmic movement such as finger or foot tapping (rhythmic movement). A post test of science scores was conducted on all the classes after the intervention. The study found that both types of science lessons were qualitatively similar in that they engendered passive-receptive modes of instructions even though one was a hands-on lab format and the other a standard lecture. The two classes that did not incorporate BCE had a decrease in post-test scores while in the BCE class more than 60% of the students’ scores increased in the post-test scores. The author discusses the findings with respect to how the study provides a lens to view African American learners’ science performance in a context that either encourages or inhibits Black Cultural Ethos. The study provides rich contextual data in addition to a rigorous controlled design which is helpful for educators to understand how BCE can be incorporated into a science lesson. ***-AS***

- Randler, C., & Hulde, M. (2007).
  Hands-on versus teacher-centred experiments in soil ecology.
  Research in Science & Technological Education, 25(3), 329-338.

Learner-centered approaches to science education have been found to be beneficial for encouraging students to autonomously explore new fields of knowledge, and to foster social competence and social learning skills. In the present study, teacher-centered and student-centered approaches to conducting science experiments were compared to determine the following: differences in achievement immediately after the event, or after a delay of four weeks; differences in the emotional responses to the different methods of learning; if there was a higher perceived difficulty of the task in the learner-centered approach; and if any gender differences were evident based on the type of method used. The students were 123 fifth and sixth graders of a German middle school. Two classes each (one fifth and one sixth) received one of the two treatments, which were assigned randomly. In the teacher-centered group, the teacher carried out the experiments and in the learner-centered group, the pupils carried out the experiments. The same three experiments were used in each group. Results indicated no differences in achievement scores immediately following the experiments. However, after a delay of four weeks, students of the learner-centered group scored significantly higher in the retention test. There were no class grade differences and girls scored higher than boys in achievement regardless of instruction method. Students in the learner-centered group expressed significantly higher interest in the experiments. Regardless of teaching method, however, students expressed high interest in all of the three experiments and reported feeling less bored, indicating an overall interest in the science experiments conducted. The authors suggest that hands-on experiments be introduced in a stepwise manner, starting with simple experiments and build to the use of more complex materials, instruments or experiments. ***-RC***

- Reid-Griffin, A., & Carter, G. (2008.)
  Uncovering the potential: The role of technologies on science learning of middle school students.
  International Journal of Science and Mathematics Education, 6(2), 329-349.

Technology can be used as a tool to improve students' science education. Several organizations, such as the American Association for the Advancement of Science and the U.S. Department of Education, have spent money to outfit classrooms with the latest technologies. This case study focused on science learning among 7th and 8th graders in a nine-week elective class on technology for gifted and talented students. Audio and video recorders were used to record student discussions and interactions. Technologies used in the class included a graphing calculator, a data collection device, a temperature probe, a voltage probe, a light probe, and a motion detector. Teachers first taught students how to use the devices and then allowed the students to explore and collect data using the objects. They then applied their knowledge to problems provided and taught their peers about the technologies in an inquiry format. Students stated hypotheses and discussed possible biases in the experiments. Some examples of experiments students conducted included temperature at various heights relative to the classroom floor; which substance heated most rapidly, water, ice, orange juice, or syrup; and which of six types of glove keeps hands warmest. The move from teacher-directed toward student-directed was found to be an effective method for engaging students in science inquiry. Technology can be a means to improving science learning, rather than an end in itself. ***-KH***

- Smith, M.H. (2008).
  Volunteer development in 4-H: Constructivist considerations to improve youth science literacy in urban areas.
  Journal of Extension, 46(4); http://www.joe.org/.

The author states that 4-H Youth Development is ideally situated to make an impact in increasing science literacy. In order for this to occur, however, 4-H volunteers need to be trained appropriately to take on the role of science educators; the use of constructivist methods for volunteer development is suggested. Constructivist theory holds that knowledge develops through experience. Three reasons for the significance of constructive methods are given: i) constructivism provides opportunities for learners to challenge their current thinking and to formulate new explanations relative to their understanding of science; ii) it is a learner-centered approach that allows for the individuals' prior experience, race, gender, class, ethnicity, culture, and language, that influence knowledge and practice; and iii) learners are able to model a process that they experience themselves which will influence how they teach youth science. A professional development training model, namely, Lesson Study, is described as one that can meet these constructivist goals. In Lesson Study, educators work in groups and engage in active reflection around interests, ideas, and issues related to a particular lesson in a specific learning setting. Participants assume a leadership role towards their own professional development. The article provides background and literature on the Lesson Study concept, citing additional resources where readers can gain more knowledge about this pedagogical method. In conclusion, the author reiterates the value of this method for 4-H volunteers, especially in the context of non-formal science education as this type of training, "respects and builds upon the knowledge and expertise" that educators already have. ***-AS***

Varelas, M., Pappas, C.C., Kane, J.M., & Arsenault, A. (2007).
Urban primary-grade children think and talk science: Curricular and instructional practices that nurture participation and argumentation.
Science Education, 92(1)*,* 65-95.

This article discusses the best ways of teaching children to think about and discuss science and scientific principles. The study focuses on the understanding of the concept of matter, including solids, liquids and gases. Children in six classrooms in first through third grade in a large Midwestern city participated. The children were taught the scientific lessons in an inquiry-based manner, distinguishing among the properties of solids, liquids, and gases such as their feel and shape, using objects as examples of different types of matter. Some of the objects the classes used to discuss matter were ambiguous to the children; for example, a plastic bag filled with air. Some children felt it was a gas (referring to the air inside), while others thought it was a solid (the bag itself). The provision of the materials allowed the children to discuss the properties amongst themselves, helped them to talk and think about science and generate arguments about it, as well as to make decisions. Children used several types of reasoning about the objects in discerning whether they were liquid, solid, or gas. They described properties of the objects; they used prototypical reasoning (naming a similar substance whose state was known, such as water); they used functional reasoning to describe how the object is used – for example, a pencil is solid because "you can write with it;" and they used process of elimination, such as shaving cream being a liquid because it is neither a solid nor a gas. The authors noted that approaches to science instruction that allow children space to think about the scientific topic and encourage discussion generate greater engagement in the topic and to support children's emerging ability to observe, describe, and debate. ***-KH***

Book Reviews . . . on topics relevant to youth development will be periodically published. We encourage submissions for future editions. Reviews may be sent to Ramona Carlos (rmcarlos@ucdavis.edu).

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