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Validation of an Interdisciplinary Food Safety Curriculum Targeted at Middle School Students and Correlated to State Educational Standards

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ABSTRACT: Providing effective food safety education to young consumers is a national health priority to combat the nearly 76 million cases of foodborne illness in the United States annually. With the tremendous pressures on teachers for accountability in core subject areas, the focus of classrooms is on covering concepts that are tested on state performance examinations. As a result, topics such as food safety are rarely addressed in middle school classrooms. Middle school is an ideal time to teach food safety because adolescents are in the process of setting lifelong behaviors; therefore, they are more likely to synthesize new food safety knowledge in a way that will lead to the development of lifelong behaviors. The purpose of this study was to scientifically validate an educational resource that provides a method for classroom teachers to involve young consumers in food safety education while meeting state content area curriculum standards. An interdisciplinary curriculum targeted at middle school students and correlated directly to state content standards was designed to include highly effective instructional strategies that teach food safety concepts through all core subject classes (science, math, social studies, and language arts). The curriculum was pilot tested in 5 schools using a pretest, posttest, and follow-up test assessment model. The results showed that the curriculum was highly effective at raising student knowledge (21% gain) and improving students' food handling behaviors (8.47% gain) from pretests to posttests. In addition, 6 wk after implementation, students retained 86% of their total knowledge gain as measured by a follow-up assessment.

Introduction

Providing effective food safety education to young consumers is a national health priority to combat the nearly 76 million cases of foodborne illness in the United States annually (ERS 2001). With the proliferation of pathogenic microbes (Byrd-Bredbenner and others 2007) and the changes in eating habits of Americans, today's youth are more at risk of contracting a foodborne illness than previous generations (ADA 1997; Coulston 1999). Researchers suggest that the most effective food safety education is tailored toward changing those behaviors that are most likely to result in foodborne illnesses: cook, clean, chill, and separate (Medieros and others 2001).

Food safety resources for use in kindergarten through 12th grade have been generated and made available by a wide variety of sources. However, these resources have not been commonly used in middle school classrooms for several likely reasons. Many teachers are unaware of available resources and uncertain of how to bring them into the classroom. Also, teachers are unlikely to teach material with which they have little background knowledge or interest. Many existing resources are produced as stand-alone units with little attention paid to educating the teacher who will implement those materials.

More problematic is that most current resources for teaching food safety in the classroom offer no direct tie-in with state curriculum standards and are, therefore, seen as extraneous. The No Child Left Behind Act of 2001 requires each state to administer annual performance assessments to all students in grades 3 to 8 and once between grades 9 to 12 (Abrams 2004). As a result, teachers report feeling tremendous pressure to focus all instructional activities on covering materials to be tested on state performance examinations (Perreault 2000). Many teachers feel that there simply is not enough time to incorporate optional materials, like food safety, that are not part of the required state standards (Pedulla and others 2003; Abrams 2004). In order for food safety curricula and resources to be effectively taught in public schools, these problems must be overcome.

Food safety education can be an enriching part of core curriculum classes (Language Arts, Math, Social Studies, and Science), thus providing students with interactive, hands-on projects and linking useful information to everyday life. However, these activities must be designed to meet state standards that are covered by grade-level accountability tests. By integrating food safety into pre-existing core curricula, these concepts will be reinforced from multiple

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sources, thus emphasizing the importance of food safety (Vars 2001; Venville and others 2004; Donovan and Bransford 2005). Students who study food safety in Language Arts, Math, Science, and Social Studies classes will receive much more exposure to these concepts than those getting nonintegrated curricula, thus allowing for a more in-depth understanding of the subject and leading to greater opportunities to affect changes in behavior, attitude, and perceptions of food safety (Blumenfeld and others 1991; Brown and Campione 1994; Berry and others 2005). Once food safety concepts are familiar to the next generation, they will be empowered to reduce occurrences of foodborne disease in their own lives. In addition, exposure to food safety in core subject areas will encourage students to develop interests and possibly pursue a career in food safety, leading to a larger and more informed group of food safety professionals in the future.

Middle school is an ideal time to teach food safety for several reasons. Adolescents are in the process of setting lifelong behaviors; therefore, they are more likely to synthesize new food safety knowledge in a way that will lead to the development of lifelong behaviors. Also, the middle school concept is based around a team teaching approach (Vars 1993). This approach allows teachers of different disciplines to coordinate their units around a single concept. When students study the same concept through a variety of disciplines, they connect what they learn to a broader range of knowledge and see a greater relevance to what they are learning (Alexander and George 1981; George and Oldaker 1985; Clark and Clark 1987, 1992; MacIver 1990; Clark 1997). Also, the middle school curriculum is more fluid and flexible than high school courses, as long as the material covered correlates to state standards for that subject area. Teaching food safety in the middle grades would allow for integration across the curriculum. As foodborne illness is a national health risk, it is imperative that students see food safety as relevant and applicable to their daily lives. Learning food safety objectives as part of each core subject class would accomplish this task.

The purpose of this study was to validate an educational resource that provides a method for classroom teachers to involve young consumers in food safety education while meeting state content area curriculum standards. The specific research questions that guided this study were: (1) What impact does the food safety curriculum have on student knowledge? and (2) What impact does the food safety curriculum have on student attitudes, dispositions, and behaviors?

Methods

Curriculum development

Two separate panels of food safety and microbiology experts, one that included the Tennessee Food Safety Task Force and the second consisting of professors from the Univ. of Tennessee's Dept. of Food Science and Technology, identified specific food safety learning objectives that were appropriate for adolescent learners. The research team then examined Tennessee and North Carolina state curriculum standards for grades 6 to 8 to look for significant areas of overlap between the skills and knowledge required to achieve the food safety objectives and those already being covered in core subject area classrooms. The 7th-grade curriculum was determined to be the best fit for both states. Once state standards were identified, the curricular activities and lessons were developed by an experienced middle school teacher. The curriculum was then reviewed by content area experts from the UT College of Education and an instructional design expert, Ms. Peggy King, to ensure that it was practically and instructionally sound. In each of these reviews, the experts looked for strength of pedagogy, practicality of classroom application (time, materials required, and so on), and alignment to state content standards. The complete curriculum is available on the project's website (www.foodsafetyintheclassroom.org).

Selection of participants

Five pilot schools in Tennessee and North Carolina were chosen based on previous working relationships with the principal investigators and their willingness to participate in the research study. The principals at each school were contacted and given information about the project that they then shared with their teachers. Schools in which an entire teaching team (math, science, social studies, and language arts) volunteered were included in the study. Participating teachers signed informed consent letters and were compensated for their participation.

The pilot test sites consisted of 2 suburban schools, 2 rural schools, and 1 urban school. Of these schools, three were performing at or above state standards in math and four were performing at or above the state standards in reading. Three of the schools had greater than 50% of students classified as "economically disadvantaged."

Delivery of professional development

Raising teacher background knowledge in food safety was crucial to empower classroom teachers to understand and feel comfortable teaching food safety objectives. To accomplish this, a 2-d professional development workshop was designed with several objectives in mind: (1) to convince teachers that food safety is an important concept to teach young people; (2) to demonstrate that the topic of food safety could be easily addressed through pre-existing standards in the curriculum by introducing teachers to the proposed integrated unit and modeling new instructional strategies; and (3) to ensure an accurate assessment of the program that was not compromised by inconsistent implementation of the curriculum. It was important that the teachers from pilot-test sites receive similar training sessions to minimize variability in the implementations.

The training workshop was designed to reflect current literature on effective professional development based on the following model:

1. Small group training held on-site at each school (Galbo 1998; Kinnucan-Welch and others 2006)
2. Delivery of instructional theory behind curriculum (Gersten and others 1997)
3. Teacher hands-on participation in completing curricular activities (Loucks-Horsley and others 1998; Cook and others 2003; Kinnucan-Welch and others 2006; Astor-Jack and others 2007)
4. Seminar style discussion of instructional strategies, ways to implement them, and possible classroom roadblocks (Galbo 1998; Kinnucan-Welch and others 2006; Astor-Jack and others 2007)
5. Informal discussions with the researchers to determine teachers' level of comfort and address concerns or implementation issues (Astor-Jack and others 2007)
6. Providing adequate supplies of materials necessary to implement the curriculum
7. On-site instructional support during the initial implementation of the curriculum (Guskey 2000; Boudah and others 2001; Fuchs and Fuchs 2001; Gersten and Dimino 2001; Cook and others 2003; Kinnucan-Welch and others 2006; Stichter and others 2006; Astor-Jack and others 2007)

Each team of teachers was trained at their own school to allow teachers to be in their own classrooms and establish a

feeling of familiarity and comfort. There was one exception where teachers in 2 schools in North Carolina were trained together to eliminate the need for additional travel for the research team. Training each school individually allowed for small groups (group sizes ranged from 2 to 8 teachers). In addition, the delivery method of the workshop was a combination of modeling of lessons and instructional strategies, hands-on participation in activities, and a seminar style discussion. The tone of the workshops was informal, and teachers were encouraged to ask questions and discuss ideas with their teammates. This method of delivery was designed to allow teachers an opportunity to apply, analyze, synthesize, and evaluate the new content knowledge as well as novel instructional strategies (Galbo 1998).

Each workshop took approximately 2 d and occurred during the summer of 2006. A set agenda was designed to move efficiently through the food safety curriculum covering new content material and instructional strategies in depth and to ensure consistency in training. Teachers were compensated at a rate of $100 per day for their participation in these workshops.

Instruments and data collection

Two research questions guided the design of this study and the data collection instruments developed for the study: (1) What impact does the curriculum have on students' food safety knowledge? and (2) What impact does the curriculum have on students' self-reported food safety behaviors and attitudes?

Each pilot school implemented the curriculum during the fall semester of the 2006 to 2007 school year. Prior to implementation, students were administered an assessment designed to measure 3 constructs: food safety knowledge, content specific knowledge (math, science, social studies, and language arts), and food handling behaviors and attitudes. Questions included in the assessment were based on the learning outcomes established for the students. This instrument was evaluated by the Univ. of Tennessee's (UT) Inst. for Assessment and Evaluation (IAE). The instrument was also field tested for reliability and validity ($\alpha = 0.868$) prior to its use by a group of similar 7th-grade students at a nonpilot test school. (See Appendix for a copy of the assessment.)

Implementation at each school required 6 to 8 school days. Throughout the implementation, project staff was on site to conduct observations and provide extra support and assistance. An observation protocol was designed by the IAE. Using the observation instrument, the researchers made note of how lessons and activities were introduced, conducted, and concluded and reflected on the teacher's apparent comfort level with instructional strategies and teaching techniques. Any teacher modification of activities was recorded as well as significant teacher or student comments. The start and stop time of each activity was also documented.

At the conclusion of the unit, each student completed a posttest that was identical to the pretest assessment. The assessment was administered a 3rd time approximately 6 wk after implementation of the curriculum. Additional data were gathered through interviews with participating teachers. Staff from IAE conducted 30-min phone interviews that followed a semistructured interview protocol. Teachers were asked to (1) share their experiences using the food safety curriculum; (2) suggest any changes they made or would make in the future; and (3) describe how well they felt the professional development workshop prepared them to use the curriculum in their classrooms. In addition, they were also asked whether the workshop and the follow-up support provided afterward met their expectations and needs.

Data analysis

Student pretest, posttest, and follow-up assessment data were scored by IAE and were itemized by student and question. Data were aggregated in Microsoft Excel by totaling each content knowledge section (Science, Language Arts, Math, and Social Studies) and adding true/false and behavior scores together for total attitudes and behaviors for each subject. Individual student assessment scores were considered outliers and removed from the data set under the following conditions: (1) the entire assessment was not finished, or (2) student responses were "offline" on the scantron sheet, giving too few or too many answers on the answer form.

Data were analyzed in the same method in 2 parts: (1) Knowledge and (2) Attitudes/Behaviors. Repeated measures analysis was used to account for the likelihood of high correlation among the data due to the nonrandom time sequencing of the assessments (Saxton 2007). Only subjects with all 3 measures (pretest, posttest, and follow-up test) were analyzed. These measures were labeled "time" and used as the within-subjects factor with 3 levels. "School" was used to indicate the place of assessment administration and was used as the between-subjects factor with 5 levels (for 5 schools). Significance values, contrasts, and estimated marginal means of within and between subject factors were obtained.

Observations were analyzed by the determination of a fidelity score to indicate how closely the teacher followed the protocol for implementing the curriculum. Each activity was given a score on a scale of 1 to 5, with 5 being the highest possible score. Comments recorded by the observer were also taken into account. In some situations the "letter" of the activity was followed (that is, teacher followed all prescribed steps) but the "spirit" was not (that is, teacher did not facilitate discussion of critical or higher order thinking questions). Points were deducted from activities where this was the case. Points were also deducted if the activity was performed out of sequence. The points awarded were divided by the total possible points to produce a percentage, and then teachers' individual fidelity scores were averaged together to produce a mean fidelity score for each pilot test site. Fidelity scores were calculated by 2 raters who had a greater than 85% inter-rater reliability and discrepancies in their scoring were resolved to determine a final fidelity of implementation score.

Teacher interview data were used in triangulation with results from other data collection. In addition, responses that commented on specific weaknesses were noted so that revisions could be made to strengthen the curriculum and resolve problems.

Results and Discussion

Student knowledge

A total of 233 students completed the pretest, posttest, and follow-up assessment. Knowledge means increased for all schools from pretest to posttest and decreased slightly from posttest to follow-up test. The mean knowledge score for students on the pretest was 51 ($\pm$ 4.9) out of 100 points. The posttest mean was 72.0 ($\pm$ 5.4) representing a 21.1-point gain. At 6 wk postintervention, the follow-up test mean was 69.0 ($\pm$6.3) demonstrating a total gain in student knowledge of 18.1 points (see Figure 1). This gain is substantial and demonstrates that the curriculum is effective in raising student knowledge of food safety concepts. In addition, 6 wk after implementation students demonstrated an 86% retention rate of new knowledge. One explanation of this high level of knowledge retention is the impact of repeated testing (pretest, posttest, and follow-up test)

as a way of aiding students in the transfer of new knowledge to long-term retention (Roediger and Karpicke 2006).

Each of the pilot test sites demonstrated a small but statistically significant decrease in knowledge from posttest to the 6-wk follow-up test (3.0 points). The exception was school 4 where student assessment scores rose 1.0 point from posttest to follow-up test (see Figure 1). While this difference is not significant, it is an interesting discrepancy in the general trend. One possible explanation of this discrepancy is that school 4 included a 5th team member (a reading teacher) who supported the implementation of the curriculum by conducting vocabulary exercises with the students. It is possible that this additional reinforcement of knowledge, coupled with strategies designed to aid students in decoding and internalizing unfamiliar vocabulary, made it easier for students to retain knowledge learned in other classes.

A test of within-subject contrasts showed that each of the test administrations (pretest, posttest, and follow-up test) was significantly different ($P < 0.01$). Repeated measures analysis revealed an interaction effect ($P < 0.05$) between time of assessment and the school of administration from posttest and follow-up tests. This suggests that differences in the implementation of the curriculum between schools impacted longer-term retention of knowledge.

Fidelity of implementation scores were derived from observations of how closely each teacher followed the curriculum's lesson plans and are reported as mean percentage score for each school. School 1 scored the highest with 81% fidelity followed by school 5 (80%), school 3 (77%), school 4 (76%), and school 2 (67%). While the correlation between fidelity scores and total student knowledge gain was weak ($r = 0.311$), the repeated measures analysis indicated that teacher modifications made to the curriculum to meet personal instructional preferences and individual student learning styles and needs had an impact on the overall student learning outcomes. This correlation will be the focus of future research.

Student attitudes/behavior

For repeated measures analysis of attitudes and behavior of students, again only students with all 3 assessment times were analyzed, for a total of 157 subjects. Site 4 was not included in the analysis because of a testing irregularity (see Figure 2). The means (out of 100 points) for attitudes and behaviors were 73.4 (± 5.1) for the pretest, 80.5 (±5.5) for the posttest, and 81.9

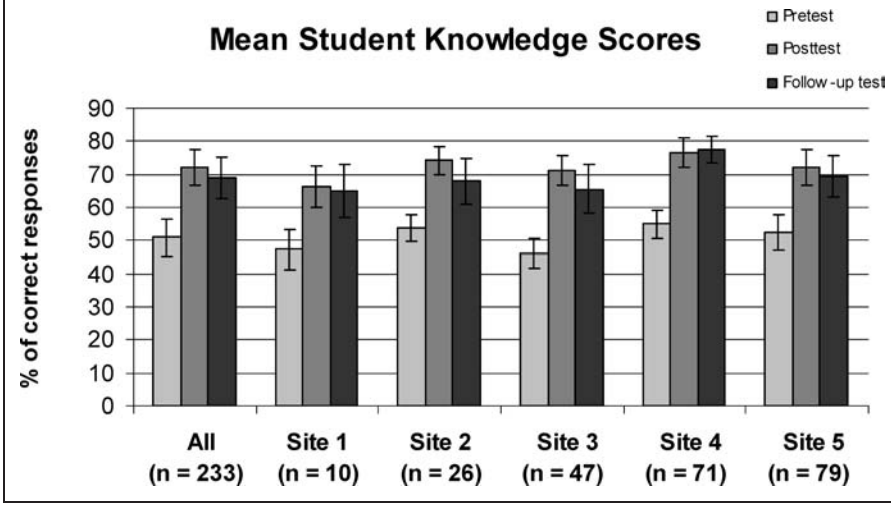

Figure 1—The mean student knowledge pretest, posttest, and follow-up assessment for all schools and each individual pilot test site ($n = 233$).

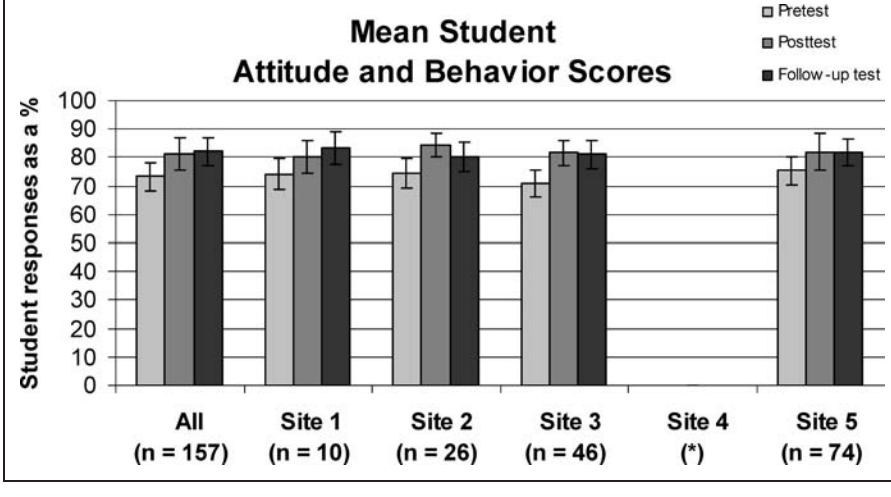

Figure 2—The mean student pretest, posttest, and follow-up assessment for attitude and behavior for all schools ($n = 157$) and each individual pilot test site. *Data for Site 4 is not included due to a testing irregularily.

(±4.9) for the follow-up test. There was a significant increase ($P < 0.001$) in the pretest and posttest for all schools, but no significant differences ($P > 0.05$) between posttest and follow-up test were found. The attitudes and behaviors were self-reported by students. It is interesting to note that while students reported high levels of safe food handling behaviors, their actual knowledge pretest scores were quite low (51 ± 4.9 out of 100 points). Other researchers have found similar behavior in middle school students (Haapala and Probart 2004). Also of interest is that self-reported behaviors and attitudes toward safe food handling increased from the posttest to the follow-up test, indicating that 6 wk post-implementation students were still making a conscious effort to modify their food handling behaviors.

There were no significant interactions ($P > 0.05$) between the time and school variables as seen in the knowledge portion, suggesting that, while teacher modification of the curriculum had a significant impact on student knowledge gain, there was no significant impact of teacher modification on student attitudes and behaviors.

Conclusions

The purpose of this study was to scientifically validate an educational resource that provides a method for classroom teachers to involve young consumers in food safety education while meeting state content area curriculum standards. The *Food Safety in the Classroom* curriculum was effective in raising student knowledge and improving self-reported attitudes and behaviors.

Future research should consider measuring observable food handling behaviors of middle school students as opposed to self-reported behavior to more accurately assess behaviors that may put adolescents at risk for foodborne illnesses. Also, given the anomalous result at pilot test site 4 where assessment scores continued to increase from the posttest to follow-up test, additional studies need to be conducted to further examine the impact of adding a vocabulary component to the curriculum. Finally, the effectiveness of the curriculum in other states with larger populations of students should be studied.

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References

Abrams LM. 2004. Teachers' views on high-stakes testing: implications for the classroom. Policy Brief. Education Policy Studies Laboratory, Arizona State Univ. College of Education.
[ADA] American Dietetic Assn. 1997. Position of the American Dietetic Association: food and water safety. J Am Diet Assoc 97:1048–53.
Alexander W, George P. 1981. The exemplary middle school. New York: Holt, Reinhart and Winston.
Astor-Jack T, McCallie E, Balcerzak P. 2007. Academic and informal science education practitioner views about professional development in science education. Sci Educ 91(4):604–28.
Berry RQ, Reed PA, Ritz JM, Lin CY, Hsiung S, Frazier W. 2005. STEM initiatives: stimulating students to improve science and mathematics achievement. Technol Teach 64(1):23–9.
Blumenfeld P, Soloway E, Marx R, Krajcik J, Guzdial M, Palincsar A. 1991. Motivating project-based learning: sustaining the doing, supporting the learning. Educ Psychol 26(3, 4):369–98.
Boudah DJ, Logan KR, Greenwood CR. 2001. The research to practice projects: lessons learned about changing teacher practice. Teach Educ Spec Educ 24:290–303.
Brown AL, Campione JC. 1994. Guided discovery in a community of learners. In: McGilly K, editor. Classroom lessons: integrating cognitive theory and classroom practice. Cambridge, Mass.: MIT Press. p 229–72.
Byrd-Bredbenner C, Maurer J, Wheatley V, Schaffner D, Bruhn C, Blalock L. 2007. Food safety self-reported behaviors and cognitions of young adults: results of a national study. J Food Prot 70(8):1917–26.
Clark S. 1997. Exploring the possibilities of interdisciplinary training. Childhood Educ 73(5):267–72.
Clark S, Clark D. 1987. Interdisciplinary teaming programs: organization, rationale, and implementation. Schools in the middle: a report on trends and practices. Reston, Va.: Natl. Assn. of Secondary School Principals.
Clark S, Clark D. 1992. The pontoon transitional design: a missing link in research on interdisciplinary teaming. Res Middle Level Educ 15(2):57–81.
Cook BG, Landrum TJ, Tankersley M, Kauffman JM. 2003. Bringing research to bear on practice: effecting evidence-based instruction for students with emotional or behavioral disorders. Educ Treat Child 26(4):345–61.
Coulston A. 1999. President's page: personal responsibility and food safety. J Am Diet Assoc 99:236.
Donovan MS, Bransford JD. 2005. How students learn: science in the classroom. Washington, D.C.: Natl. Academies Press.
[ERS] Economic Research Service. 2001. ERS estimates foodborne disease costs at $6.9 billion per year. U.S. Dept. of Agriculture. Available from: http://www.ers.usda.gov/Emphases/SafeFood/features.htm#start. Accessed Oct 10 2007.
Fuchs D, Fuchs LS. 2001. One blueprint for bridging the gap: Project Promise: practitioners and researchers orchestrating model innovations to strengthen education. Teach Educ Spec Educ 24:304–14.
Galbo C. 1998. Helping adults learn. Thrust Educ Leadersh 27(7):13–5.
Gersten R, Dimino J. 2001. Realities of translating research into classroom practice. Learn Disabil Res Pract 16:120–30.
Gersten R, Vaughn S, Deshler D, Schiller E. 1997. What we know about using research findings: implications for improving special education practice. J Learn Disabil 30:466–76.
George P, Oldaker L. 1985. Evidence for middle school. Columbus, Ohio: Natl. Middle School Assn.
Guskey TR. 2000. Evaluating professional development. Thousand Oaks, Calif.: Corwin Press.
Haapala I, Probart C. 2004. Food safety knowledge, perceptions, and behaviors among middle school students. J Nutr Educ Behav 36(2):71–6.
Kinnucan-Welch K, Rosemary C, Grogan P. 2006. Accountability by design in uteracy professional development. Read Teach 59(5):426–35.
Loucks-Horsley S, Hewson P, Love N, Stiles K. 1998. Designing professional development for teachers of mathematics and science. Thousand Oaks, Calif.: Corwin Press.
MacIver D. 1990. Meeting the needs of young adolescents: advisory groups, interdisciplinary teaching teams, and school transition programs. Phi Delta Kappan 71(6):458–64.
Medieros L, Hillers VN, Kendall PA, Mason A. 2001. Food safety education: what should we be teaching to consumers? J Nutr Educ 33(2):108–13.
Pedulla J, Abrams L, Madaus G, Russell M, Ramos M, Miao J. 2003. Perceived effects of state-mandated testing programs on teaching and learning: findings from a national survey of teachers. Chestnut Hill, Mass.: Natl. Board on Educational Testing and Public Policy, Boston College.
Perreault G. 2000. The classroom impact of high-stress testing. Education 120(4):705–10.
Roediger HL III, Karpicke JD. 2006. The power of testing memory: basic research and implications for educational practice. Persp Psychol Sci 1:181–210.
Saxton A. 2007. Design and analysis of biological data. Knoxville, Tenn.: Univ. of Tennessee.
Stichter JP, Lewis TJ, Richter M, Johnson NW, Bradley L. 2006. Assessing antecedent variables: the effects of instructional variables on student outcomes through in-service and peer coaching professional development models. Educ Treat Child 29(4):665–92.
Vars G. 1993. Interdisciplinary teaching in the middle grades: how and why. Columbus, Ohio: Natl. Middle School Assn.
Vars G. 2001. Can curriculum integration survive in an era of high-stakes testing? Middle School J. 33(2):7–17.
Venville G, Rennie L, Wallace J. 2004. Decision making and sources of knowledge: how students tackle integrated tasks in science, technology, and mathematics. Res Sci Educ 34:115–35.

Appendix—Student Knowledge, Attitudes, and Behaviors Assessment Instrument

Directions: Read each of the following statements or questions below and choose the BEST answer from the choices given.
Science

1. Which of the following is NOT true about bacteria?
   - ○ They are microscopic.
   - ○ They are made up of only one cell.
   - ○ They can be found on most surfaces.
   - ○ All bacteria can make you sick.
2. Which of the following is NOT one of the three basic shapes of bacteria?
   - ○ Circular
   - ○ Bacilli
   - ○ Spiral
   - ○ Cocci
3. When bacteria grow they:
   - ○ Grow in size from an infant to an adult.
   - ○ Grow in number, not in size.
   - ○ Eventually get too big and die.
   - ○ Require more and more food to grow larger.
4. How do bacteria get the nutrients they need to survive?
   - ○ Some make their own energy from sunlight.
   - ○ Some scavenge their nutrients from the environment around them.
   - ○ Some attach to other living things.
   - ○ All of these are true.
5. A pathogen is:
   - ○ A bacterium that helps in digestion.
   - ○ A bacterium used to make pepperoni.
   - ○ A bacterium that can make you sick.
   - ○ A bacterium used to make medicines.
6. An example of indirect contact is:
   - ○ Touching the desk and then touching your eyes, mouth, or nose.
   - ○ Getting a kiss on the cheek from Aunt Mildred.
   - ○ Shaking hands with a friend.
   - ○ Hugging your parents.
7. Which of the following is NOT a food made using helpful bacteria?
   - ○ Pickles
   - ○ Eggs
   - ○ Pepperoni
   - ○ Sauerkraut
8. All of the following are pathogens EXCEPT:
   - ○ *Salmonella*
   - ○ *Lactobacillus*
   - ○ *E. coli*
   - ○ *Listeria*
9. The best way to avoid getting sick from a pathogen is to:
   - ○ Rinse your hands in cold water for 5 seconds.
   - ○ Wash your hands in warm water with soap for 20 seconds.
   - ○ Avoid touching any surface.
   - ○ Wipe your hands on a dish towel.
10. Bacterial cells are different from animal cells in that bacteria cells:
    - ○ Contain DNA.
    - ○ Have a cell wall.
    - ○ Do not have a nucleus.
    - ○ Contain cytoplasm.

Language Arts

11. Which of the following is considered a bacterial "hot zone" in your house?
    - ○ Kitchen
    - ○ Living Room
    - ○ Bedroom
    - ○ Closets
12. The MOST IMPORTANT thing you can do to keep from getting sick from bacteria is to:
    - ○ Refrigerate leftovers.
    - ○ Wash your hands.
    - ○ Frequently wipe kitchen surfaces.
    - ○ Use a hand sanitizer.
13. Which is the BEST example of cross-contamination?
    - ○ Using the same knife to cut raw chicken and vegetables.
    - ○ Leaving food sitting at room temperature for too long.
    - ○ Not reheating food properly.
    - ○ None of the above.
14. Leftover foods should be refrigerated within:
    - ○ 30 minutes
    - ○ 1 hour
    - ○ 2 hours
    - ○ 3 hours
15. Bacteria grow most rapidly at temperatures of:
    - ○ At zero degrees.
    - ○ Below 40 degrees.
    - ○ Above 140 degrees.
    - ○ Between 40–140.
16. The safest way to tell if a hamburger is cooked to the proper temperature is to:
    - ○ Use a food thermometer.
    - ○ Check the inside to see if it is still pink.
    - ○ Burn the outside of the burger.
    - ○ None of the above.
17. The purpose of a press release is to:
    - ○ Track outbreaks of foodborne illnesses.
    - ○ Share information or news with the media.
    - ○ Determine the cause of a foodborne illness.
    - ○ Sell products or services.
18. Which of the following is NOT part of a press release?
    - ○ Title page.
    - ○ Contact information.
    - ○ Headline.
    - ○ Dateline.
19. When writing a press release you should:
    - ○ Tell the audience that the information is intended for them and why they should read it.
    - ○ Start with a brief description of the news, and then explain who announced it, and not the other way around.
    - ○ Avoid excessive use of adjectives and fancy language.
    - ○ All of these are true.
20. Which of the following is a possible outcome of NOT handling food properly?
    - ○ Getting sick and requiring medical attention.
    - ○ Getting sick for a few days and then feeling better.
    - ○ Not getting sick at all.
    - ○ All of these are possible outcomes.

Continued

Appendix—Continued

Math

21. It is okay to eat raw cookie dough:
   - ○ anytime. The raw eggs will not hurt you.
   - ○ only if the cookie dough is homemade.
   - ○ only if the cookie dough is store bought.
   - ○ never. Raw cookie dough puts you at risk for salmonellosis.

22. The safest way to defrost frozen meat is to:
   - ○ set it out on the counter.
   - ○ cook it while it is frozen.
   - ○ place it in the refrigerator.
   - ○ None of the above.

23. To make sure that your hamburger is safe to eat it should be cooked to an internal temperature of:
   - ○ 160 F.
   - ○ 200 F.
   - ○ 180 F.
   - ○ 212 F.

24. A data set with data points of (1, 2, 3, 4, & 5) would have a mean of:
   - ○ 2.5
   - ○ 3.5
   - ○ 3.0
   - ○ 5

25. A data set with the data points of (16, 17, 22, 22, 25, & 30) would have a mode of:
   - ○ 6
   - ○ 22
   - ○ 14.0
   - ○ 26.4

26. A data set with data points of (6, 7, 7, 10, & 16) would have a range of:
   - ○ 5
   - ○ 9.2
   - ○ 7.0
   - ○ 10

27. A data set with data points of (2, 4, 6, 8, & 10) would have a median of:
   - ○ 5
   - ○ 6
   - ○ 5.6
   - ○ 8

28. Jimmy is exactly 5 feet tall. His height at 4× and 10× would be:
   - ○ 5 ft and 10 ft
   - ○ 20 ft and 50 ft
   - ○ 9 ft and 15 ft
   - ○ 20 ft and 40 ft.

29. If a bacterium's generation time was 10 minutes and you started with one bacterium, how many bacteria would there be after one hour?
   - ○ 1
   - ○ 32
   - ○ 6.0
   - ○ 64

30. The difference between a sample and a population is:
   - ○ a sample is selected from a population.
   - ○ a sample refers to people and a population refers to objects.
   - ○ a population is selected from a sample.
   - ○ There is no difference between a population and a sample.

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31. A foodborne illness is
   - ○ any illness that humans get from food.
   - ○ only preventable with a vaccine.
   - ○ an illness you are born with.
   - ○ cannot be passed from one person to another.

32. Which of the following can case a foodborne illness?
   - ○ Bacteria
   - ○ Parasites
   - ○ Viruses
   - ○ All of these can cause a foodborne illness.

33. Which of the following is NOT a common symptom of foodborne illnesses?
   - ○ Chest pains
   - ○ Vomiting
   - ○ Diarrhea
   - ○ Headache

34. You should wash your hands
   - ○ after using the bathroom.
   - ○ more frequently when someone around you is sick.
   - ○ before handling food.
   - ○ All of these are true.

35. Most foodborne outbreaks are caused by:
   - ○ not keeping food hot or cold enough.
   - ○ cross-contaminating raw and cooked foods.
   - ○ poor personal hygiene (not washing your hands).
   - ○ None of the above.

36) The bacteria with an onset time of 30 minutes to 8 hours is :
   - ○ *Salmonella*
   - ○ *E. coli* O157:H7
   - ○ *Staphylococcus aureus*
   - ○ *Listeria*

37. The life expectancy rate in a county is:
   - ○ the number of people expected to die each year.
   - ○ the quality of life a person in that county can expect.
   - ○ the average number of years a person in that county can expect to live.
   - ○ none of the above.

38. A country's percentage of arable land tells us:
   - ○ the percentage of land in that country that cannot be used to grow crops.
   - ○ the types of crops grown in that county.
   - ○ the percentage of land in that county that is suitable for growing crops.
   - ○ None of the above.

39. Which of the following does NOT need to be done in order to avoid foodborne illnesses?
   - ○ Make sure that all food is thoroughly cooked.
   - ○ Refrigerate all leftovers immediately.
   - ○ Throw away leftovers.
   - ○ Separate meat and veggies when preparing foods.

40. When researching outbreaks of foodborne illnesses it is important to know:
   - ○ the location of the outbreak.
   - ○ the likely cause of the outbreak.
   - ○ the number of reported cases of illness.
   - ○ All of these are true.

Continued

Appendix—Continued

For the following statements: Fill in the appropriate bubble if the statement is TRUE or FALSE.	**TRUE**	**FALSE**
41. It is possible to wash my hands thoroughly using only water.	○	○
42. When preparing food, it is okay to use the same surfaces (cutting board, counter top) and utensils for meats and vegetables.	○	○
43. It is okay to eat pizza that has been sitting out on the counter all night as long as I warm it up first.	○	○
44. Most people go to the doctor when they get food poisoning.	○	○
45 More people are hospitalized each year with food poisoning than with the flu.	○	○
46. Almost all food-poisonings are preventable.	○	○
47. Food-poisonings only occur in under-developed countries.	○	○
48. If I clean a surface with soap and water, it will kill all the bacteria.	○	○
49. Water can make me sick.	○	○
50. Bacteria cannot grow in foods stored in the refrigerator.	○	○
51. There are bacteria in my food that can make me sick if my food is not handled correctly.	○	○
52. All bacteria can make me sick.	○	○
53. A bacteria cell is different from an animal cell because the bacteria cell does not have a nucleus.	○	○
54. Bacterial growth means an orderly increase in the number of bacteria.	○	○
55. To prevent cross-contamination, it is important to keep raw meat, poultry, and seafood away from other foods in the grocery cart and refrigerator.	○	○

For the following statements, fill in the bubble of the choice that applies most often.	**Never**	**Rarely**	**Sometimes**	**Usually**
The statement is *never* true.				
The statement is *rarely* true.				
The statement is *sometimes* true.				
The statement is *usually* true.				
56. I feel that I know how to correctly handle my food so that I do not become sick.	○	○	○	○
57. When preparing food, I carefully follow temperature and time directions on the food packaging labels.	○	○	○	○
58. If necessary, I could properly handle a variety of meats and vegetables to prepare a safe meal for my family.	○	○	○	○
59. I wash my hands before preparing or eating food.	○	○	○	○
60. When I see an adult handling food improperly, I point out her or his mistakes.	○	○	○	○
61. I can identify foods that have a higher risk of making me sick.	○	○	○	○
62. I use hand sanitizer to clean my hands	○	○	○	○
63. I wash my hands after each time I use the restroom.	○	○	○	○
64 I can recognize the most common symptoms of food poisoning.	○	○	○	○

Thank you for participating in this survey.