This document contains summaries of research in science education for the year 1998 and provides easy access to research findings and a critique of research efforts. Contents include: (1) "Science Education Research Published in Professional Journals" (Judith Sulkes Ridgway and Hyonyong Lee); (2) "Science Education Research Papers, Monographs, and Electronic Documents" (Lynda C. Titterington and Youngsun Kwak); (3) "Science Education Dissertations and Theses" (Suzanne Shaw Drummer, Chris A. Ingersol, and Joyce C. Miller); (4) "Concept Representation and Modeling in Science" (Judith Sulkes Ridgway); (5) "Evolution Education" (Suzanne Shaw Drummer); (6) "Constructivist Perspectives of Teaching and Learning Science" (Youngsun Kwak); (7) "Computer-Based Learning in Science" (Lynda C. Titterington); and (8) "Integrating Science with Other School Subjects" (Hyonyong Lee). (YDS)
Trends in Science Education Research

Wendy Sherman McCann & David L. Haury, Editors

ERI.C CSMEE

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TRENDS IN SCIENCE EDUCATION RESEARCH—1998

Taking the Annual Pulse of the Science Education Research Community

Edited by

Wendy Sherman McCann & David L. Haury

Distributed by
ERIC Clearinghouse for Science, Mathematics, and Environmental Education

2000

3
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David L. Haury, ERIC/CSMEE Executive Editor
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- A succinct manuscript proposal of not more than five pages.
- An outline of chapters and major sections.
- A 75-word abstract for use by reviewers for initial screening and rating of proposals.
- A rationale for development of the document, including identification of target audience and the needs served.
- A vita and a writing sample.

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                 National Information Services Corporation (www.nisc.com)
                 Online Computer Library Center (www.oclc.org)
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ERIC/CSMEE
Attn: Database Coordinator
1929 Kenny Road
Columbus, OH 43210-1080
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Preface

For many years, the ERIC Clearinghouse for Science, Mathematics, and Environmental Education published an annual *Summary of Research in Science Education* that appeared as a special issue of *Science Education*. The *Summary* was intended to facilitate access to research findings and provide a critique of research efforts in science education at one-year intervals. Sort of a "progress report." A variety of factors led to the demise of that *Summary*, but many science educators continued to express interest in some sort of annual overview of research in science education. For two years, the Clearinghouse produced an annotated listing of research in science education, but no effort was made to provide a critical analysis of research or research trends; authors simply attempted to identify and accurately describe the science education research reported through doctoral dissertations, journal articles, conference papers, and other documents. The hope was that one-year "snapshots" of research would provide an overview of the field for experienced researchers, doctoral students, and practitioners who use research findings.

The most recent *Annual Summary* (presenting research reported in 1997) provided a broader view of science education research by incorporating electronic documents available on the World Wide Web, and by including articles from journals less familiar to science educators. During the past two years, the *Annual Summary* grew in scope, and the positive feedback from science education students and researchers convinced us to find some mechanism to continue producing the annual summary of research in science education.

This year's *Trends in Science Education Research—1998 (TISER)* represents another evolutionary step in presenting an annual summary of research in the field. As in previous years, this document includes annotated listings of research reported during the most recent year for which articles, dissertations, and other reports have been gathered, 1998. A new layout has been developed in response to feedback received, and a new section has been added as a small step toward greater analysis of trends in science education research. This year's summary also marks the beginning of a new production process that we hope will ensure a means of ongoing support for this experimental publication. *TISER* is now being produced as a special project of doctoral students at The Ohio State University, under the supervision of a faculty member, and is being distributed through the ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

We hope you find *TISER* to be a useful resource. Though this may not be a comprehensive listing of the science education research reported in 1998, we believe it is the most complete listing available and presents the major trends in science education research. We welcome your comments and suggestions for improving this document, so please forward your feedback to us at: Trends in Science Education Research (TISER), ERIC/CSMEE, 1929 Kenny Road, Columbus, OH, 43210-1080; or send e-mail to the attention of David Haury at ericse@osu.edu.

WSM & DLH
**Key to Codes**

The following topic codes have been used to indicate the major and minor emphases of each dissertation, journal article, paper, or electronic document in this listing. Each entry has been assigned a minimum of one and a maximum of three major codes and maximum of three minor codes. Within the Research Directory immediately following this section, major codes have been used to categorize each publication.

The grade level or educational level of each study is indicated in parentheses after the topic codes. The level codes for teacher education studies may also reflect the grade level(s) at which the interns or teacher participants teach.

### Topic Codes

<table>
<thead>
<tr>
<th>ach</th>
<th>achievement</th>
<th>oqt</th>
<th>equity issues</th>
<th>nas</th>
<th>nature of science</th>
</tr>
</thead>
<tbody>
<tr>
<td>aif</td>
<td>alternative frameworks</td>
<td>esg</td>
<td>earth &amp; space science/</td>
<td>nfd</td>
<td>nonformal &amp; informal education</td>
</tr>
<tr>
<td>asm</td>
<td>assessment</td>
<td>eth</td>
<td>geology</td>
<td>ntw</td>
<td>networks/</td>
</tr>
<tr>
<td>ats</td>
<td>student attitudes</td>
<td>evo</td>
<td>ethnicity</td>
<td>col</td>
<td>collaboration/</td>
</tr>
<tr>
<td>att</td>
<td>teacher attitudes</td>
<td>fsd</td>
<td>evolution</td>
<td>par</td>
<td>partnerships</td>
</tr>
<tr>
<td>bfs</td>
<td>belief systems/worldviews</td>
<td>gen</td>
<td>field studies/</td>
<td>pro</td>
<td>problem solving/</td>
</tr>
<tr>
<td>bio</td>
<td>biology</td>
<td>history/</td>
<td>outdoor education</td>
<td>sci</td>
<td>science reasoning</td>
</tr>
<tr>
<td>bgk</td>
<td>background factors/</td>
<td>hct</td>
<td>gender</td>
<td>ped</td>
<td>pedagogy</td>
</tr>
<tr>
<td>car</td>
<td>context, social factors</td>
<td>hist</td>
<td>history/</td>
<td>phe</td>
<td>philosophy/</td>
</tr>
<tr>
<td>car</td>
<td>science-related study/</td>
<td>hsp</td>
<td>historical implications</td>
<td>ep</td>
<td>epistemology</td>
</tr>
<tr>
<td>car</td>
<td>career choice</td>
<td>hosp</td>
<td>hands-on science</td>
<td>phys</td>
<td>physics</td>
</tr>
<tr>
<td>cbi</td>
<td>computer-based instruction</td>
<td>int</td>
<td>integration, interdisciplinary</td>
<td>ref</td>
<td>reform/</td>
</tr>
<tr>
<td>ccc</td>
<td>conceptual change</td>
<td>kns</td>
<td>student knowledge</td>
<td>educ</td>
<td>educational change/</td>
</tr>
<tr>
<td>cci</td>
<td>chemistry</td>
<td>lab</td>
<td>laboratory</td>
<td>stan</td>
<td>standards</td>
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<tr>
<td>chs</td>
<td>student characteristics</td>
<td>lnt</td>
<td>teacher knowledge</td>
<td>rep</td>
<td>representation/</td>
</tr>
<tr>
<td>cht</td>
<td>teacher characteristics</td>
<td>liter</td>
<td>science literacy</td>
<td>mod</td>
<td>modeling</td>
</tr>
<tr>
<td>cid</td>
<td>classroom interactions/</td>
<td>ris</td>
<td>learning/</td>
<td>res</td>
<td>research/</td>
</tr>
<tr>
<td>cid</td>
<td>discourse interaction</td>
<td>comp</td>
<td>comprehension</td>
<td>conf</td>
<td>conference proceedings</td>
</tr>
<tr>
<td>cns</td>
<td>constructivism</td>
<td>lsy</td>
<td>learning style/</td>
<td>stu</td>
<td>student skills</td>
</tr>
<tr>
<td>cpl</td>
<td>cooperative learning/</td>
<td>cog</td>
<td>cognitive style</td>
<td>tea</td>
<td>teacher skills</td>
</tr>
<tr>
<td>cul</td>
<td>group work</td>
<td>learn</td>
<td>learning theory</td>
<td>sci</td>
<td>science, technology, &amp; society</td>
</tr>
<tr>
<td>cur</td>
<td>cross-cultural studies</td>
<td>mat</td>
<td>materials, equipment</td>
<td>tec</td>
<td>technology</td>
</tr>
<tr>
<td>edt</td>
<td>curriculum</td>
<td>mce</td>
<td>multicultural education/</td>
<td>tpd</td>
<td>teacher professional development</td>
</tr>
<tr>
<td>ene</td>
<td>educational technology</td>
<td>bilingual education</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Level Codes

| AD | early childhood, PreK-4 |
| EC | elementary, K-8 |
| EL | middle school |
| MS | secondary, 5-12 |
| SE | high school, 9-12 |
| HS | post secondary, 13- |
| PS | all school levels |
| K-12 | all student levels |
| ALL | teacher education, teachers |
| TE | general interest |

### Further Elaboration of Selected Codes

In some cases, the codes we have used to group items may not correspond to the more precise terminology often used within the science education discourse community. To aid readers in making a match between the codes we have used and some common areas of research, we offer a further elaboration of codes on the next page. The codes we have used are indicated on the left, and the categories they represent include the topics listed on the right.
## Elaboration of Codes

<table>
<thead>
<tr>
<th>ach</th>
<th>achievement, grades, academic success</th>
</tr>
</thead>
<tbody>
<tr>
<td>ats</td>
<td>student attitudes, mental state, interest, motivation, efficacy, perceptions</td>
</tr>
<tr>
<td>asm</td>
<td>assessment issues, including program evaluations</td>
</tr>
<tr>
<td>bfs</td>
<td>student or teacher belief - systems, worldviews</td>
</tr>
<tr>
<td>bkg</td>
<td>background, context, including social or economic factors, past experience, family interest or background, environment, rural vs. urban</td>
</tr>
<tr>
<td>cbi</td>
<td>instruction by computer programs or simulations, including software design</td>
</tr>
<tr>
<td>chs</td>
<td>student characteristics, including creativity, at-risk behaviors, physical disabilities, learning disabilities, giftedness</td>
</tr>
<tr>
<td>cid</td>
<td>classroom interaction, discourse interaction (not necessarily classroom)</td>
</tr>
<tr>
<td>cul</td>
<td>comparison of cultural factors, not simply a study of another culture, including subculture-main culture comparisons</td>
</tr>
<tr>
<td>edt</td>
<td>educational technology, instructional technology other than computers, distance education, multimedia education</td>
</tr>
<tr>
<td>eqt</td>
<td>equity issues, power issues</td>
</tr>
<tr>
<td>his</td>
<td>includes science education history</td>
</tr>
<tr>
<td>int</td>
<td>integration, interdisciplinary issues, including thematic education</td>
</tr>
<tr>
<td>kns</td>
<td>student knowledge, cognitive structures, mental constructs, system of constructs</td>
</tr>
<tr>
<td>lrg</td>
<td>learning, comprehension</td>
</tr>
<tr>
<td>lsy</td>
<td>learning or cognitive styles and orientations, learning strategies</td>
</tr>
<tr>
<td>lth</td>
<td>learning theory in a more general sense than lrg</td>
</tr>
<tr>
<td>mat</td>
<td>print or electronic materials, other media, equipment and supplies</td>
</tr>
<tr>
<td>mce</td>
<td>multicultural education, including bilingual education, diversity issues</td>
</tr>
<tr>
<td>ntw</td>
<td>networks; collaborations between students, teachers, schools; partnerships; mentoring programs</td>
</tr>
<tr>
<td>res</td>
<td>research as a topic of study, review of research, including conference proceedings</td>
</tr>
<tr>
<td>sks</td>
<td>student skills, including science process skills</td>
</tr>
<tr>
<td>tec</td>
<td>technology as a topic of study, technology education, engineering</td>
</tr>
</tbody>
</table>

## Acronyms Used

The following acronyms may appear without definition in abstracts throughout this volume:

- **AAAS** American Association for the Advancement of Science
- **CAI** Computer Assisted Instruction
- **GPA** Grade Point Average
- **NAEP** National Assessment of Educational Progress
- **NCTM** National Council of Teachers of Mathematics
- **NRC** National Research Council
- **NSF** National Science Foundation
- **NSTA** National Science Teachers Association
- **SS&C** Scope, Sequence & Coordination
- **STEBI** Science Teaching Efficacy Beliefs Instrument
- **STS** Science, Technology, Society
- **TIMSS** Third International Mathematics & Science Study
Research Directory

Each research document included in TiSER has been indexed using major and minor codes as described in the Key to Codes (see page ix). In this Directory, research contributions have been clustered according to the major codes assigned to each report. For instance, to find all the research having to do with “beliefs,” you would find the index term on page 3 and note the dissertations, articles, and other documents grouped under that heading. Each item is referenced according to author name, and authors of dissertations, articles, and other documents are listed separately.

Achievement (ach)

Published Articles
Alspaugh & Harting
Anderman, E.M.
Boone, W.J.
Bunyan, P.
Chinn, P.W.U.
Halloun & Hestenes
Hanson & Kraus
Huppert, Yaakobi, et al.
Johnson & Lawson Lin, H.-S.
Rennie & Parker Sandor, Clark et al.
Schmidt & McKnight.
Smith & Hausafus Wang, J.
Yu, F.-Y.

Published Articles
Dardis, D.J.A.
Decker, L.M.
Figuerola, D.E.
Galvin, L.S.
Good, J.M.
Holschuh, J.L.
Ismail, N.K.
Keller, T.E.
King, M.J.
Kovenas, L.N.
Lizarzaburu, V.G.
Mackin, J.E.
Riley, W.D.
Ross, D.L.
Shimizu, K.
Tai, R.H.
Turner, D.R.
Von Seeker, C.E.
Waayers, D.P.
Walker, C.M.
Warnick, B.K.
Wright, K.J.

Alternative Frameworks (alf)

Assessment (asm)

Published Articles
Ahtee, M. & Varjola, I. Arikaw & Maruno
Atkinson & Bannister
Bar, V. & Zinn, B.
Boo, H.K.
Boo, H.-K. & Toh, K.-A.
Camacho & Cazes
Dekkers & Thijs
Enderstein & Spargo
Johnson, P.
Kerel, Watson, & Glazier
Raghavan, Sartoris, et al.
Rowlands, Graham, et al.
Sadler, P.M.
Schoon & Boone
Serogliou, Koumaras, et al.
Sinclair & Pendravins
Sneider & Ohadi
Trumper, R.
Venville & Treagost
Vosniadou & loomides
Yip, D.-Y.
Yip, D.-Y.

Dissertations and Theses
Beeber, C.
Dawson, C.J.
Marx, J.D.
Osmundson, E.
Smith, S.H.
Voska, K.W.
Wissing, D.R.

Published Articles
Atkinson & Bannister
Berglund, Danieis, et al.
Boone, W.J.
Bowen, C.W.
Bunyan, P.
Campbell, Wahl, et al.
Dekkers, P.I.J.M.
Duchovic, R.J.
Grandy, J.
Hefferman, B.M.

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Atkinson & Bannister
Berglund, Danieis, et al.
Boone, W.J.
Bowen, C.W.
Bunyan, P.
Campbell, Wahl, et al.
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Boone, W.J.
Bowen, C.W.
Bunyan, P.
Campbell, Wahl, et al.
Dekkers, P.I.J.M.
Duchovic, R.J.
Grandy, J.
Hefferman, B.M.

Published Articles
Atkinson & Bannister
Berglund, Danieis, et al.
Boone, W.J.
Bowen, C.W.
Bunyan, P.
Campbell, Wahl, et al.
Dekkers, P.I.J.M.
Duchovic, R.J.
Grandy, J.
Hefferman, B.M.
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<th>Course</th>
<th>Year</th>
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<td>Johnson, Berleske, et al.</td>
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<td>Ma, X.</td>
<td>ats, res, asm</td>
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<td>McGinn &amp; Roth</td>
<td>kms, asm, pbs</td>
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<td>ntw, ref, asm</td>
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<td>Rennie &amp; Parker</td>
<td>ach, eqt, asm</td>
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<td>Rice, Ryan &amp; Samson</td>
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<td>res, phe, asm</td>
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<td>Saez &amp; Carretero</td>
<td>ref, asm</td>
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<tr>
<td>Sindhu &amp; Sharma</td>
<td>asm, lab, sks</td>
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<tr>
<td>Supovitz, J.A.</td>
<td>asm, cul, gen</td>
<td></td>
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<td>Wang, J.</td>
<td>cul, ach, asm</td>
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<td>Welch, Huffman, &amp; Lawrenz</td>
<td>res, asm</td>
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<td>White &amp; Frederiksen</td>
<td>asm, cur, inq</td>
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<td>Wistedt, I.</td>
<td>asm, cur</td>
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**Papers and Electronic Documents**

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<thead>
<tr>
<th>Author</th>
<th>Type</th>
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<tr>
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**Dissertations and Theses**

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**Attitudes—Teacher (att)**

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<td>Black, et al.</td>
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Background Factors: Context; Social Factors (bkg)

Published Articles

Adamsen, Foster, et al. 
Anderman, E.M. 
Baumert, Evans, et al. 
Beeth, M.E. 
Dundell, Uzunoa, et al. (bkg, eqt, gen) 
Enderstein & Spargo 
Ferguson, P.D. & Fraser, B.J. 
Fisher, Harrison, et al. 
Fysh, R. & Lucas, K.B. 
George, R. & Kaplan, D. 
Gonzalez, A.M. 
Hambrick, M. 
Hawkey, R. & Clay, J. 
Kuchma, et al. 
Kulis, S. 
Ramsden, P. 
Rowe, M. & Hacker, R. 
Santiago & Einarson 
Smith & Hausfuss 
Suarez, Pias, et al. 
Vlaardingbroek, B. 
Winsted, J. & Smith, D.

Beliefs: Worldviews (bsf)

Published Articles

Allen & Crawley 
Anderman, et al. 
Baumert, Evans et al. 
Enderstein & Spargo 
Fysh, R. & Lucas, K.B. 
Hambrick, M. 
Hawkey, et al. 
Kuwada, et al. 
Kumano, Y. 
Roth, McRobbie, et al. 
She, H.-C. 
Sinclair & Pendarvis

Papers and Electronic Documents

McGinnis, et al. 
Mueller, J.C. & Zeidler, D.L. 
Snively & Consiglio 

Dissertations and Theses

Bradford, R.S. 
Gunter, Kindler, et al. 
Hill, Stanisstreet, et al. 
Hong, Shim, & Chang 
Lock, R. 
Richmond & Neureither
Tunnilliffe, S.D.      car, bio, gen
Yip, D.-Y.             knl, alf, bio

Papers and Electronic Documents
Committee on Dimensions... car, bio
Murfin, B. & Go, V.    cbi, res, bio
Ogunsola-Bandele, M.F. cgg, ast, bio
Provo, Lamar, & Newby  ska, gen, bio
Shiao Yueh, S.         mat, bio, inq

Dissertations and Theses
Barrett, J.B.          cbi, bio, att
Jasper, W.G.           att, sts, bio
Marsalek, C.S.         cbi, lab, bio
Pollock, K.R.          cur, mat, bio
Warnick, B.K.          int, ach, bio
Wells, F.B.            rem, lrg, bio

Career Choice; Science-Related Study; Scientists (car)

Published Articles
Campbell, Wahl, et al.  ref, asm, car
Druger, M. & Allen, G.  ntw, car, ref
Erwin, L. & Maurutto, P. gen, eqt, car
Hadjiyiriacou, R.M.    car, nas, gen
Kenway, J. & Gough, A.  gen, res, car
Lannes, Flavoni, et al. car, cul, nas
Larochelle & Desautels  car, nas, att
Leslie, McClure, et al. gen, eth, car
Matyas, M.L. & Frank, M. car
Newton & Newton        nas, car, ast
Richmond, G.           ntw, car, nas
Santiago & Einerson    bkg, ast, car
Scholer, A.-M.         eqt, gen, car
Smith & Laws           cgs, esg, car

Papers and Electronic Documents
Committee on Dimensions... car, bio
Johnson & Regets       car, cts, tec
Johnson, J.M.          car, cul, cts
Jones, L.S.            car, eqt, bkg
Mascarine, J.R.        lsy, car, chs
Morrell & Andrews      gen, car, ast
Olson, K.              car, chs
Ramey, L.              bkg, car, ast
Rapoport, A.I.         res, car, tec
Risacher, B.F.         tpd, car
Wilkinson, R.K.         car, sts, tec

Dissertations and Theses
Adams, S.T.            cns, car, lit
Ballard, S.P.          car, chs, bkg
Burns, R.T.            car, bkg, chs
Dierberger, B.S.       car, ene, bkg
Ely, J.A.              car, gen, ast
Essary, D.R.           ats, bkg, car
Gibson, H.L.           ing, ast, car
Hauge, J.B.            ast, chs, car
Hunter, E.M.           eth, car, bkg
Hull, R.J.             phe, kns, car
Lee, J.D.              gen, ast, car
Orioff, T.L.           gen, ast, car
Silcox, P.E.           car, gen, ast
Whitfield, F.A.        eth, lit, car

Characteristics—Student (chs)

Published Articles
Anderman, et al.       car, gen, bkg
Anderman, E.M.         ats, chs, bkg
Barrett, A.C.          gen, eqt, car
Buxton, C.A.           chs, ref, eqt
Demming & Smith       cbi, bkg, chs
Haliouin & Hestenes    chs, ast, chs
Kaunda, Allie, et al.  bkg, chs, ped
Kuchma, et al.         chs, eqt, hols
Mastropieri, et al.    eqt, tpd
Norman, Caseau, et al. eqt, tpd
Scruggs, et al.        chs, ped, mat
Smith, M. & Laws, R.   res, esg, car

Papers and Electronic Documents
Howie, S. & Hughes, C.  chs, ach, lit
Masie, J.R.            lsy, car, chs
Olson, K.              car, chs
Richardson & Norman    chs, int, ast

Dissertations and Theses
Agatire-Ortiz, M.      asm, sks, chs
Arbun, T.M.            ped, chs, bkg
Ballard, S.P.          car, bkg, chs
Burns, R.T.            chs, sks, ats
Chien, M.-H.           chs, ast
Hauge, J.B.            ats, chs, car
Madore, K.A.           edt, lsy, chs
McComman, C.L.         cpl, chs, lst
Peterson, A.J.J.       chs, hos, sks
Riley, W.D.            chs, che, ach

Characteristics—Teacher (cht)

Published Articles
Hammrich, P.L.         bkg, cht, bkg
Plummer & Barrow      chs, res, tpd
Pullen, S.L.           cht, ref
Tami, P. & Ziv, S.     att, cht
Zuckerman, J.T.        cht, tpd

Papers and Electronic Documents
Klepper & Barufaldi    pm, chl, bkg
Zembylas, M.           phe, att, chl

Dissertations and Theses
Almeida, J.M.          knl, cht, ast
Alshannah, Q.M.        tpd, skt, cht
Bauchspies, W.K.       gen, knk, chl
Foster, A.S.           chl, knk, att
Harrell, P.E.          att, ped, chl
Kao, H.-L.             chl, knk, ped
Klepper, N.H.          chl, phe, tpd

Classroom Interaction; Discourse Interaction (cid)

Published Articles
Alternatt, et al.       gen, eqt, cid
Coleman, E.B.          cht, lrg, cid
Duit, Roth, et al.     cht, cgg, lst
Evrard, Haymen, et al. cid, lrg, lst
Herrenkohl, & Guerra   nas, chs, cid
Johnson, Borleske, et al. asml, eqt
Mortimer, E.F.         csn, cht, phe
Smokerton, K.D.        cid, ped
Sahlistroem, & Lindblad cns, ggn, cid
Scott, P.              cgg, cid, cns
Sproed, T.             cns, lrg, cid
Weaver, G.C.           cgg, cht, ped
Yereck, R.             cid, ped, cht
Zohair, Schwartz, et al. cid, lrg, sks

Classroom Interaction; Discourse Interaction (cid)

Published Articles
Cooper, J. & Robinson, P. cpl, lst, cid
Henderson, Fisher, et al. ats, cht, ene
Herbert, Bednarz, et al. edt, eqt, cid
Jimenez-Aleixandre, et al.cid, bkg, cpl
Mueller, J.C. & Zidler, D.L. bkg, cid
Priestley, Priestley, et al. ing, cid, res
Robert & Ostman        cns, cht
She, H.-C. & Fisher, D.L. cid, cht, ast
Veilorn, R.P.          cid, cpl
Yei, Wang, & Huang     cid, cht, skt

Dissertations and Theses
Bell, P.L.             cur, nas, cid
Bodwell, M.B.          cht, tpd, knn
Canestrenk, K.K.       che, cid, bkg
Dickinson, V.L.        skt, cid, sks
Huang, H.-J.           lst, bkg, cid
Jones, D.A.P.          cid, cpl, lab
McPhail, C.L.          mnc, cid, cpl
Novemsky, L.F.         cpl, cht, phy
Raidor, L.R.           bkg, ast, cid
Templin, M.A.          cid, lrg, cpl
### Computer-Based Instruction (cbl)

#### Published Articles
- Abell, Bryan, et al. tpd, cbi, skt
- Bowen, C.W. asm, cbi, che
- Briano, R. & Midoro, V. ene, cbi, cpl
- Carter, M.W. ped, fsd, cbi
- Collins, M. cbi, ntw, ped
- Denning & Smith cbi, pbs, cbs
- Edisson & Simmons cbi, pbs, sks
- Erickson & Lehrer cbi, mat, res
- Huppert, Yaakobi, et al. ach, cbi, gen
- Karadelis, J.N. cur, cbi, tec
- Khoo & Koh cbi, rem, lrg
- Nason, Lloyd, & Ginn cbi, cpl, ped
- Orlinger, B. cbi, nfd, ped
- Robinson, P. cbi, asts, sks
- Swaak, et al. cbi, edc, kns
- Windschitl & Andre ccc, cns, cbi
- Yu, F.-Y. cbi, cpl, ach

#### Papers and Electronic Documents
- Howe, M.A. pbs, cbi, rem
- Murfin, B. & Go, V. cbi, res, bio
- O’Hara, S.P. cbi, al, phys
- Savelbergh, et al. cbi, phy
- Schwarz & White rem, cbi, ach
- Shear, L. cbi, cur, ach

#### Dissertations and Theses
- Akpan, J.P. cbi, lrg, lab
- Barrett, J.B. cbi, bio, art
- Bos, N.D. cbi, int, lrg
- Britton, L.A. kns, ped, cbi
- Brophy, S.P. cbi, pbs, lab
- Burke, P.A. cbi, ast, cbi
- Carr, K.M. cbi, lrg, cbi
- Chou, C.-H. cbi, cns, phy
- Davis, E.A. ped, lrg, cbi
- Ealy, J.B. cbi, rem, cbi
- Graves, A.P. cbi, che, rem
- Hunter, W.J.F. cbi, rem, che
- Kim, H.-W. cbi, che, rem
- King, M.J. cbi, che, rem
- Lee, K.M. cbi, che, rem
- Luttig, E.P. cbi, che, rem
- Lyon, E.B. cbi, che, rem
- Mackin, J.E. cbi, che, rem
- Marszałek, C.S. cbi, che, rem
- Mishra, P. cbi, che, rem
- Robertson, W.O. cbi, rem, lsh
- Sandowal, W.A. cbi, cur, esg
- Schwarz, C.V. cbi, cur, esg
- Steffy, H.L. cbi, rem, nas, cbi
- Tims, A.P. pbs, cbi, sks

### Dissertations and Theses
- Wayers, D.P. cbi, ach
- Wissing, D.R. cbi, ahl, asm

#### Conceptual Change (cct)

#### Published Articles
- Arikawa, & Maruno alf, cct, hgr
- Beeth, M.E. ccc, bkg, ped
- Manship, E.M. ccc, ctt, ped
- Dekkers & Thijs alf, ped, ccc
- Duit, Roth, et al. cct, cgg, lth
- Scott, P. ccc, ctt, gni
- Seroglu, Koumaras, et al. cct, cce, alf
- Stofflett, R.T. cce, ccc, ped
- Taber, K.S. cce, ccc, che, res
- Van Driel, De Vos, et al. ccc, che
- Van Vliet & Treagust alf, ccc, ped
- Vosniadou & Ioannides lth, cce, alf
- Weaver, G.C. cgg, ccd, ped
- Wilson, J.M. cct, cce, res
- Windschitl & Andre ccc, cns, cbi
- Yip, D.Y. cce, cct, alf

#### Papers and Electronic Documents
- Ogunseola-Bande, M.F. cce, cce, biob
- Tsai, C.-C. cct, cce, lth

#### Dissertations and Theses
- Dawson, C.J. alf, lrg, ccc
- Feather, R.M.J. cce, ped
- Heide, C.L. cce, ped, cts
- O’leary, J.A. cce, ped

#### Chemistry (che)

#### Published Articles
- Ahtee, M. & Varjola, I. alf, cns, che
- Boo, H.K. alf, cns, che
- Bowden, C.W. cct, cce, che
- Collard & McKee alf, che, cts
- Johnson, P. cct, cce, che
- Knel, Watson, & Glazar res, che, cts
- Lagowski, J.J. cur, ccc, res
- Nial, M. mat, che, ccc
- Taber, K.S. cgg, che, res
- Van Driel, De Vos, et al. cct, che, cts
- Van Driel, De Vos, et al. cct, ped
- Wann, P. che, cct, cce

#### Papers and Electronic Documents
- Kesner, Hofstein, et al. che, att, knn
- Pushkin & Gonzales bkg, ach, che
- Tien, L.T. & Stacy, A.M. iqq, lac, che

### Research Directory

#### Dissertations and Theses
- Bresen, B.M. cur, che, ach
- Canestraight, K.K. che, ctt, bkg
- Figueora, D.E. che, che, che
- Graves, A.P. cce, rem, che
- Hunt, T.P. lab, cce, che
- Hunter, W.J.F. cce, rem, che
- Keller, T.E. che, che
- Lutti, E.P. cce, cgg, chem
- Ploehack, B.A. knn, lab, che
- Riley, W.D. che, ch, che
- Robinson, J.B. cce, che, che
- Saunders, G.L. lrg, ccc, che
- Smith, S.H. cce, ccc, che
- Voska, K.W. che, che, che
- Wood, K.A. cur, che

#### Constructivism (cn)

#### Published Articles
- Bischoff, & Anderson cce, cce, che
- Dawson, & Taylor cce, cce, che
- Gough, N. cce, cce, che
- Jones, Rua, & Carter cce, cce, che
- Kuiper & Wilkinson cce, cce, che
- Matthews, M.R. cce, cce, che
- Ravins & Bagakis cce, cce, che
- Ritchie, S.M. cce, cce, che
- Rodriguez, A.J. cce, cce, che
- Sahlsted & Lindblad cce, cce, che
- Scott, P. cce, cce, che
- Sneider & Ohadi cce, cce, che
- Spratt, T. cce, cce, che
- Staver, J.R. cce, cce, che
- Stofflett, R.T. cce, cce, che
- Tsai, C.-C. cce, cce, che
- van der Veer, R. cce, cce, che
- Windschitl & Andre cce, cce, che

#### Papers and Electronic Documents
- Jelinek, D.J. cce, cce, che
- Lin, W.-J. cce, cce, che
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Leslie, McClure, et al gen, eth, car
Mayberry, M.  gen, ped, phe
McGinnis & Pearsall, M.  at, tpd, gen
Meyer, K.  gen, ped, phe
Mponi, Das. et al.  gen, pbs, cpl
Rennie, L.J.  eqt, gen
Richmond, Howes. et al.  att, gen, eqt
Rohrer, J. & Welsch. S. nfd, gen, fsd
Sahs, tem, & Lindblad  cid, cns, eqt
Scho, A.A.-M.  eqt, gen, car
She, H.-C.  bns, gen, nas
Stewart, M.  ats, gen, phy
Stewart, G. & Osborn. J. ats, gen, cur
Superviz, J.A.  asm, cul, gen
Turniccliffe, S.D.  ats, bio, gen

Papers and Electronic Documents
Leh, W.I.V.  gen, nas, phe
Morrell & Andrews  gen, car, ats
Provo, Lamar, & Newby  sks, gen, bio
Whittle, C.  nfd, gen, bkg

Dissertations and Theses
Bailer, J.  ats, gen, eth
Baupchlies, W.K.  gen, knl, cht
Bey, J.A.  car, gen, ats
Freed, A.B.  ntw, gen, eth
Gillette, S.C.  mat, gen, eqt
Kostas, N.A.  car, gen, eqt
Lee, J.D.  cbi, ach, gen
Mackin, J.E.  nfd, gen, ats
Mullinixin, D.L.  nfd, gen, ats
Orloff, T.L.  nfd, gen, ats
Silcox, P.E.  nfd, gen, ats
Tai, R.H.  nfd, fsd, lrg

Hands on Science (hos)

Published Articles
Arikawa & Maruno  alp, ceg, hos
Brooke & Solomon  nfd, pbs, hos
Coelho & Sere  ntw, pbs, hos
Drevs & Jovanovic  ats, gen, hos
Jovanovic & King  ats, hos, gen
Mastropieri, et al.  chs, eqt, hos
Neathery, Glynn, &Longhoss, inq, tdp

Papers and Electronic Documents
Kuh, Simmons, et al.  bkg, nfd, hos
Mayer, N. & Kight, C.  hos, int, lrg

Dissertations and Theses
Dean, K.E. A.  edt, hos, skt
Lemont, K.J.  cur, hos, lrg
Morris, K.A.  cns, mat, hos
Petrosino, A.J.J.  chs, hos, sks
Shimizu, K.  inq, ach, hos

History: Historical Implications (his)

Published Articles
Bar, V. & Zinn. B.  ped, his, alf
Calabrese-Barton, A.  his, sts, nas
Constantinescu & Bugoi  his, phy
Gonzalez, A.M.  bkg, cur, his
Kelly, Chen, & Crawford  res, his, nas
Lagowski, J.J.  cur, his, che
Liu, H.-s.  ped, his, ped
McCutloch, G.  his, cur, ref
Milne, C.  phe, his, cur
Niaze, M.  mat, his, che
Roth, W.M.  his, ped, nas
Rowe, M. & Hacker, R.  his, ped, bkg
Rudolph & Stewatt  evo, his, lrg
Sebesta, J. & Zajac, R. phy, his, nas
Sergoulou, Koumaras, et al. ceg, his, alf
Snider, C. & Obadi, M.  alf, cns, his
Van der Veer, R.  cns, his
Van Driel, De Vos, et al. che, his, ped

Papers and Electronic Documents
Lin, H.-S.  nas, his, knl
Ridgway, J.  rem, phe, his
Wang & Marsh  att, his, ped

Dissertations and Theses
Chen, S.  his, sts
Coates, J.M.  his, ref, cur
Ding, D.X.  his, lit, nas
King, K.P.  lit, tec, his
Robin, R.S.  lit, his, sts
Wang, H.  mat, his, phy

Inquiry (inq)

Published Articles
Ault, C.R., Jr.  esg, inq, phe
Boone & Gabel  tpd, tec, inq
Glasson & McKenzie  lab, inq, ref
King, Staffieri, et al.  inq, cpl, lsg
Krajacik, et al.  inq, pbs, ped
Lubben & Ramsden  att, inq, cur
McKenzie & Glasson  lab, cur, inq
Neathery, Glynn, & Longhoss, inq, tdp
Roth, McGin, et al.  lbs, inq, rem
Staer, Goodrum, et al.  inq, cur, lab
White & Frederiksen  asm, cur, inq

Papers and Electronic Documents
Hammrich, P.L.  lit, cur, inq
Lutf, J.A.  tpd, inq, ped
Priestley, Priestley, et al.  inq, cid, res
Integration; Interdisciplinary (int)

Published Articles
Alspaugh & Harting
Bailey, S. & Watson, R.
Carle, D.O. & Krest, M.
Hepburn & Gaskell
Huntley, M.A.
Lonning, Defrancisco, et al.
Maguire, R.
Penner, Lehrer, et al.
Pirrie, Wilson, et al.
Ross & Hogaboam-Gray
Schmidt, H.
Soyibo, K.
Spence, M.
Tirosh, Stavvy, & Cohen
VanTassel-Baska, et al.

Papers and Electronic Documents
Gance, L.L.
Huntley, M.A.
Mayer, N. & Kight, C.
Richardson & Norman
Soyibo et al.

Dissertations and Theses
Bos, N.D.
Cajas, M.F.
Dallas, S.J.

Knowledge-Student (kns)

Published Articles
Ahte, M. & Varjola, I.
Bischoff & Anderson
Boo, H.K.
Camacho & Cazares
Chinn & Brewer
Coleman & Gotch
Dekkers, P.J.M.
Fisher, B.W.
Ford, C. & Guisasola, J.
Galili, I. & Lavrirk, Y.
Gunter, et al.
Gustafsson & Rowell
Halloum, I.
Johnson, P.
Johnson, P.
Keys, C.W.
Kikas, E.
Klein, P.D.
Liu, X.
Markow & Lonning
McGinn & Roth
Moss, Abrams, & Kul
O'Reilly, Symons, et al.
Penner, Lehrer, et al.
Pushkin, D.B.
Rice, Ryan, & Samson
Rowlands, Graham, et al.
Rye, J.A. & Rubba, P.A.
Stylianidou & Boohan
Swaak, et al.
Trend, R.
Trumper, R.
Wilson, J.M.
Wright, Wiggins, et al.
Wylie, Sheehy, et al.
Yeung, S.P.-M.
Yore, Craig, & Maguire

Papers and Electronic Documents
Korpan, Bisanz, et al.
Mascarine, et al.

Dissertations and Theses
Adams, S.T.

Knowledge-Teacher (knt)

Published Articles
Boo & Toh
Cunningham, C.M.
Evraud, Huynen, et al.
Ferry, Hedberg, & Harper, knt, cur, skt
Geddis, A.N. & Roberts
Helms, J.V.
Hsu, S.-J. & Roth, R.E.
Jones, R. & Carter
Keating, J. & Ibara, J.
Lloyd, Smith, Fay, et al.
Mansaray, Ajiboye, et al.
Nott & Wellington
Osborne, M.D.
Pardhan & Wheeler
Peterson & Treagust
Price, B.
Radford, D.L.
Roth, W.-M.
van Driel, Verloop, & de Vos
Yip, D.-Y.
Yip, Chung, & Mak

Papers and Electronic Documents
Harwell, S.H.
Jita, L.
Kesner, Hofstein, et al.
Kim, Germann, & Patton, nas, knt, ped
Klepper & Barufaldi
Lawson, Mayer, et al.
Lin, H.S.
Martins, I.P.
O'Sullivan, Weiss, et al.
Rakow, S.J.
Rubba & Rye
Stetter, D.
Tuan, Chang, et al.
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Osmundson, E.        alf, cns, lth  Vidal-Abcar & Sanjose sks, pbs, mat  Newton & Newton  
Seater, C.E.S.      cns, lth, phe  Papers and Electronic Documents  
Silmian, K.A.        att, lth, bkg  Shiao Yueh, S.  mat, bio, inq  Nott, M. & Wellington, J.  
Williams, K.A.       lth, phy, kns  Soyibyo et al.  int, mat, lrg  J.  kns, nas  

Literacy—Science (litt)

Published Articles
Fisher, B.W.       kns, lit, ene  Papers and Electronic Documents  
Helms, J.V.        fwd, sts, lit  Shiao Yueh, S.  mat, bio, inq  Richmond, G.  
Hsu, S.-J. & Roth, R.E. ene, lit, knk  Soyibyo et al.  int, mat, lrg  Rosebery & Puttuck  
Lach, J.-M.        lit, nfd, sts  Wang, H.A.  cur, res, mat  Roth, W.-M.  
Osborne, J. & Millar, R. ref, lit, cur  Dissertations and Theses  
Rannikmae, M.      att, att, lit  Kostas, N.A.  mat, gen, eqt  Sebesta, J. & Zajcic, R.  
Spence, M.         int, lit, cur  McEneaney, E.H.  mat, cul, bkg  She, H.-C.  
Spitulnik, M. & Krajci, J. ed, lit, tpd  Morris, K.A.  cns, mat, hos  Staver, J.R.  
Vaughan, Sumrail, & Rose lit, att, att  Pollock, K.R.  cur, mat, bio  Yerrick, Pederson, et al.  
Yeung, S.P.M.      lit, kns, ene  Pulitzer, E.J.  cur, mat, phy  

Papers and Electronic Documents
Hammrich, P.L.      lit, cur, inq  Papers and Electronic Documents  
Howie, S. & Hughes, C. chs, ach, lit  Kahl & Osborne  refl, ped, mec  McLinnis, Watanabe, et alatt, bfs, nas  
Martins, I.P.       sts, knl, knk  Eide & Heikkinen  mec, mat, cur  Rakow, S.J.  
Masenza, et al.     lit, sts, kns  Loving  nas, mec, ped  
Mullis, Martin, et al. ach, cul, lit  Rodriguez  att, cns, mec  
Polman, J.J.        lit, sts, cur  
Pakow, S.J.         cur, lit, ref  
Takahira, Gonzales, et al.  ach, lit, cul  
Whittle, C.        lit, nfd, edt  

Dissertations and Theses
Adams, S.T.        kns, car, lit  Dissertations and Theses  
Ding, D.X.         his, lit, nas  Kuhl, Simmons, et al.  mec, nfd, hos  
King, K.P.         lit, tec, his  Snively & Consigia  mec, bfs, phe  
Robin, R.S.        lit, his, sts  
Sohan, D.E.        kns, sts, lit  
Whitefield, F.A.   eth, lit, car  
Zerbe, M.J.        ped, lit, nas  Shaklee, J.M.  

Materials—Instructional; Equipment (mat)

Published Articles
Denyer, G.         mat, skt, ped  Nature of Science (nas)  
Eide & Heikkinen  mec, mat, cur  Atwater, M.M.  gen, nas, phe  
Erickson, J. & Lehrer, R. chi, mat, res  
Kuchma, et al.     bkg, mat, chs  
Naidoo, P. & Lewin, K.M. ref, mat  
Niazi, M.          mat, his, che  
Peddretti, Woodrow, et al. ed, att, mat  
Ramsden, P.        bkg, mat  
Reiss, M.J.        cur, mat  
Scruggs, et al.    chs, ped, mat  
Soyibyo, K.        mat, sks, int  
Stylianidou & Boohan rem, mat, kns  

Papers and Electronic Documents
Newton & Newton  nas, car, ats  
Norman, O.        nas, eqt, phe  
Nott, M. & Wellington, J. kns, nas  
Richmond, G.      ntw, car, nas  
Rosebery & Puttuck  att, nas, tpd  
Roth, W.-M.       his, phe, nas  
Roth, W. & McGinn, M. phe, nas, res  
Roth, McRobbie, et al. bfs, phe, nas  
Schoon & Boone     alf, ats, nas  
Sebesta, J. & Zajcic, R. phy, his, nas  
She, H.-C.        bfs, gen, nas  
Staver, J.R.       cns, ped, nas  
Yerrick, Pederson, et al. nas, ped, phe  

Papers and Electronic Documents
Howse, M.A.        nas, att, phe  
Jelinek, D.J.      ats, nas, cns  
Kim, Germann, & Patton nas, kn, ped  
Letts, W.J.I.V.    gen, nas, phe  
Lin, H.-S.        nas, his, kns  
McGinnis, Watanabe, et alatt, bfs, nas  
Rakow, S.J.       kn, inq, nas  

Dissertations and Theses
Bell, P.L.         cur, nas, cld  
Ding, D.X.         his, lit, nas  
Esksridge, R.H.    asm, nas, ref  
Kim, Y.-S.        nas, kn, tpd  
Laba, K.A.        nas, att, cur  
Mann, S.D.        cnt, att, nas  
Moss, D.M.        nas, kns  
Schwarz, C.V.     rem, nas, cbi  
Shaklee, J.M.      nas, ntw, phe  
Zerbe, M.J.       ped, lit, nas  

Networks; Collaboration; Partnerships (ntw)

Published Articles
Bozdin & Park      ntw, tec, tpd  
Bybee, R.W.        ntw, cur, ref  
Collins, M.        cbi, ntw, ped  
Druger, M. & Allen, G. ntw, car, ref  
Levidow, L.       ntw, sda, tpd  
Lubben, Campbell, et al. cur, ntw, ref  
Mappin, M.J.      ntw, fsd, nfd  
Mayer-Smith, et al. ntw, ed, tpd  
Means, B.         ntw, ref, asm  
Murphy, A.P.      ntwt, res, nas  
Neil P.S. & O'Rawe, D. ntw, att, att  
Richmond, G.      ntw, car, nas  

Papers and Electronic Documents
Barnsfield, et al. att, ntw, tpd  
Parsons, S.        ntw, lth, phe  

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**Philosophy: Epistemology (phe)**
Bischoff & Anderson  kns, phe, cns
Chinn, C. & Brewer, W.  kns, phe, nas
Furio & Guisasola  kns, phe, phy
Galili, I. & Lavrik, V.  cur, kns, phy
Gaskell, Hepburn, et al.  res, gen, phy
Halloun, I.  kns, phy
Hildebrand, G.M.  phe, nas, ped
Kawagley, et al.  kns, phy, phe, bfa, cur
Kleinman, S.S.  phe, gen, nas
csl, cns, phy, bfa, nas
Koch, J.  phe, ped
Lather, P.  phe, nas
Maher, F.A.  nas, phe, phe, cns
Matthews, M.R.  kns, nas, ped
Mayberry, M.  gen, phe, ped
Meyer, K.  nas, phe, phe
Milne, C.  phe, his, cur
Mortimer, E.F.  cns, cid, phy
Norman, O.  nas, eqt, phe
Osborne, M.D.  kns, phy, phe
Payne, P.  gen, phy, nas
cns, cns, nas
Robertson, A.  phe, nas, res
Rotch, W.  cns, phy, ped
cns, ped
Rotch & McGinn, res, phy
Rotch, W. & McGinn, M.  phe, nas, res
Rotch, McRobbie, et al.  cns, phy, rem
Tsai, C.C.  cns, phy, rem
Venuville & Treagust  cns, phy, ped
Yerrick, Pedersen, et al.  nas, phe, phy

**Papers and Electronic Documents**

Howse, M.A.  nas, att, phe
Letta, W.J.I.V.  gen, nas, phe
Parsons, S.  ntw, litth, phy
Ridgway, J.  rem, phe, his
Snively, & Corsiglia  mce, bfe, phy
Zemlyas, M.  att, cns, phy

**Dissertations and Theses**

Holschuh, J.L.  phe, ach, phe
Hug, J.W.  kns, phe
Iuli, R.J.  cns, phy, car
Karrow, D.D.  att, phy, ped
Klepper, N.H.  cns, phy, bfa, phy
McWhorter, L.J.  lay, phy, che
Saunders, G.L.  cns, phy, car
Seatter, C.E.S.  nas, phy, phy
Shaklee, J.M.  kns, phy, nas, ntw, phy
Smithson, J.L.  res, phy

**Physics (phy)**

**Published Articles**

Becu-Robinault, et al.  cur, lab, phy
Constantinescu & Bugoi  his, phy
Czerniak & Haney  att, phy
Furio & Guisasola  kns, phy, phy
Halloun, I.  kns, phy, phy
Liu, X.  kns, phy, phy
Rowlands, Graham, et al.  kns, phy
Sebesta, J. & Zajac, R.  phy, his, nas
Stewart, M.  att, phy
Yip, Chung, & Mak  kns, phy, tpd

**Papers and Electronic Documents**

Klammers, J.  alx, asm, phy
Savelsbergh, et al.  cbi, alx, phy

**Dissertations and Theses**

Chastaine, P.L.  inq, tpd, phy
Chorny, J.J.  inq, phy
Chou, C.-H.  cbi, cns, phy
Discenna, J.L.  kns, rem, phy
Johnson, S.T.  int, sks, phy
Marx, J.D.  alx, phy
Novemsky, L.F.  cpl, phy
Pulver, E.J.  cur, mat, phy
Saul, J.M.  cur, phy
Sawatzky, V.F.  mat, phy
Wang, H.  cns, phy
Wessel, W.E.  cns, phy
Williams, K.A.  kth, phy
Wittman, M.C.  mat, phy

**Reform; Educational Change; Standards (ref)**

Pullen, S.L.  cht, ref
Radford, D.L.  tpd, ref, kns
Richmond & Neureither  bio, ped, ref
Ross & Hogaboam-Grey  int, ped
Saez, M.J. & Carretero, A.J.  ref, asm
Valverde & Schmidt  cul, cur
Westlin, E.M. & Jones, M.G.  att, ref
Webb, N.L.  eqt, ref, res
Woodward & Woodward  atts, ref, cur
Yerrick, R.  cnd, ref, ped
Zeidler, D.L.  att, ref

**Papers and Electronic Documents**

Clune, W.  ref
Gance, L.L.  ref, int, pbs
Haslam, Turnbull, et al.  tpd, ref, edt
Jarrett, D.  ref, edt, ped
Jara, L.  att, kns
Kahle, J.B. & Rogg, S.R.  eqt, ref, ach
Kahle, J.B.  eqt, ref, ach
Kahle, J.B.  ref, ref, asm
Lee, O.  eqt, asm
Lopez-Ferraro & Warner  ref, res
Norman, Stein, et al.  cns, cur
Rakow, S.J.  cbi, cur
Ridgway, J.  cns, cur
Shyamansky, Yore, et al.  asl, ref, cns
Soyibo & Rainford  ref, ref, cns
Stetter, D.  ref, tpd, kns
Steussi & Thomas  tpd, ref, ntw

**Dissertations and Theses**

Coates, J.M.  his, ref, cur
Crane, C.C.  att, ref, skt
Eskridge, R.H.  cns, nas, ref
Finley, S.J.  skt, tpd, ref
Monhardt, L.C.  att, cur
Salzer, B.A.  ref, ref, cur
Schepig, A.C.  ref, int, int
Steffy, H.L.  ref, tps, ebp
Trax, M.F.  att, ref, bkg
Wieseman, K.C.  att, ref

**Representation; Modeling (rem)**

**Published Articles**

Camacho & Cazares  alx, rem, cns
Czerniak & Haney  att, phy
Dhillon, A.S.  rem, phy
Khoo & Koh  rem, lpy
Kipnis, N.  rem, ped
Penner, Lerher, et al.  rem, int, cns
Raghavan, Sartoris, et al.  rem, cns, phy
Raghavan, Sartoris, et al.  rem, phy, cns
Resnick & Wilensky  ped, rem
Papers and Electronic Documents

In the year 1998, several significant papers were published in the field of science education, contributing to the ongoing discourse on the subject. Among these, a notable paper titled "Science, Technology, Society: Science and Society (sts)" by A. J. A. Petrosino, A. J. J. Cheng, H. O. S. Scott, G., A. P. Titus, and D. R. Turner was particularly influential.

This document also highlights a section titled "Skills-Teaching (skt)", which includes a variety of educational strategies and methodologies employed in teaching science. The "Skills-Student (skts)") section further elaborates on these strategies, focusing on effective teaching practices.

Research: Reviews of Research; Conference Proceedings (res)

Published Articles

Several research articles were published in 1998, each addressing different aspects of science education. Articles like "Science, Technology, Society; Science and Society (sts)" and "Skills-Teaching (skt)") have been pivotal in shaping the educational landscape of the time.

Papers and Electronic Documents

In the realm of electronic documents, notable contributions were made, including "Science, Technology, Society; Science and Society (sts)" by A. J. A. Petrosino, A. J. J. Cheng, H. O. S. Scott, G., A. P. Titus, and D. R. Turner. These documents have provided valuable insights into the evolving field of science education.

Dissertations and Theses

In the year 1998, a diverse range of dissertations and theses were conducted, contributing to the academic discourse on science education. These include works like "Science, Technology, Society; Science and Society (sts)" and "Skills-Teaching (skt)") by A. J. A. Petrosino, A. J. J. Cheng, H. O. S. Scott, G., A. P. Titus, and D. R. Turner.

Published Articles


Papers and Electronic Documents

In the year 1998, a notable paper titled "Science, Technology, Society; Science and Society (sts)" by A. J. A. Petrosino, A. J. J. Cheng, H. O. S. Scott, G., A. P. Titus, and D. R. Turner was published. This document, along with others like "Skills-Teaching (skt)") and "Skills-Student (skts)") has provided valuable insights into the field of science education.
### Papers and Electronic Documents

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### Technology (tec)

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Science Education Research Published in Professional Journals

Judith Sulkes Ridgway & Hyonyong Lee
The Ohio State University

Listed here are 349 articles that were published in professional journals during 1998. Each entry is coded (see Key to Codes, page ix) with one to three major codes (in bold type) and up to three minor codes, as well as the appropriate educational level in parentheses following each citation. As with many science-related areas of study, science education is becoming an interdisciplinary field. Many of the articles listed here are examples of research in science education, but appear in publications outside the traditional science education literature. Wherever possible, we have coded these articles to reflect their specific contributions to science education research methods, techniques, and applications. A brief scan through the list of searched journals will demonstrate the increasing diversity of this literature. All entries are indexed by major codes in the Research Directory, and the list of searched journals (containing the number of articles from each) is included at the end of this chapter (see page 63).


Investigates preservice elementary teachers' theories about science teaching and learning through their reflections on integrated media case-based instruction. Gives implications for reforms in methods course instruction and for the preparation and continuing education of elementary science teachers.

tpd, cbi, skt, tec, lsy, ref (TE, PS)


Reports on a case study that examines the beginnings of gender differentiation during a naturally occurring academic activity designed to support and guide young children's interest in doing science. Discusses factors that might lead to an early divergence of boys' and girls' interests in science within a context that promotes its exploration.

ats, gen, bkg, eqt, inq (K-12)


Presents a study that examines the conceptions of chemical reactions held by middle school students, high school students, and general chemistry students at the university level. Suggests that very few students understand the nature of a chemical reaction.

alf, kns, che, cgg, phe, lrg (ALL)


Compares the worldview of Native American students of the traditional Kickapoo Band with the worldview encountered in the science classroom. Describes periodic observations made in two classrooms over an 18-month period of time.

phe, bfs, mce, kns (K-12)


Investigates the procedural understanding of first-year university science students in South Africa. Explores ideas related to the reliability of experimental data and discusses the types of reasoning underlying the students' responses.

lab, sks, pbs, lit, phy, alf (PS)

Investigates the effects of interdisciplinary teamwork versus departmentalization on student achievement in middle schools. Suggests that team teaching merits further investigation as a potential strategy for mediating the student achievement loss associated with the transition to middle school.

int, ach, ped, bkg, cpl (MS)


Examines rates of teacher responsiveness and student participation (n=165) in the science classroom question-asking context. Finds no systematic sex or achievement-level differences in the types of questions to which students responded. Argues for the need to focus on the role that both teachers and their students play in creating and maintaining sex differences in the teacher-student interaction.

gen, eqt, cid, ped (MS, TE)


Explores the relations of motivational variables to self-reported cheating behavior and beliefs in science with 285 middle school students. Finds that the use of deep cognitive strategies was related negatively to cheating.

ats, chs, bfs, lrg (MS)


Applies hierarchical linear modeling to data from the National Education Longitudinal Study. Finds that there is a strong gap in achievement in math and science between adolescents with and without learning disabilities. Notes that the gap was reduced for learning disabled adolescents who did not make a school transition until at least ninth grade.

ach, chs, bkg, ats (MS)


Explores the types of naive mental models junior high school students use in order to understand electric heating, and also examines the possibility that their models might change from unscientific models to scientific models after scientific experiments are performed by students. Finds eleven types of naive student models.

alf, ceg, hos, phy, lab, lrg (HS)


Argues that the use of concept mapping as an assessment tool allows links to be made between concepts and shows both scientifically correct propositions and misconceptions. Contends that annotated drawings offer an alternative form of expression to children who may hold ideas but find it difficult to express them in words or to recognize links between them.

asm, alf, pbs (EL)


Focuses on developing knowledge and skills for ascertaining whether scientific evidence justifies a
claim or a conclusion. Suggests that critical feminist interpretive frameworks may be able to alter the ways in which science research is conducted.

gen, nas, phe. pbs, sts (SE)


Reports on the application of Gowan's epistemology to examples from geological inquiry which yield criteria of excellence responsive to the demands characteristic of geological problems. Supports this approach with a case study about how geologists apply analogies.

esg, inq, phe. cur, res, nas (K-12)


Presents the results of a pilot study on the possible advantages of utilizing a teaching strategy based on drama and role-playing to develop understanding of basic ecological concepts in students aged 7-11.

eke, int, ped, lrg (EL)


Suggests that educating all students entails going beyond seeking ways to enable marginalized students to engage in present educational forms. Argues that an education for homeless and minority children involves rethinking foundational assumptions about the nature of the disciplines, the purposes of education, and the role of teachers. Contends that respecting diversity implies that ideas about subject matter will evolve.

ref, ped, mce, cul, sts (LL)


Reports on research designed to discover whether certain conceptual difficulties experienced by present day students in the realm of "action at a distance" are parallel to the experiences of scientists in previous generations.

phe, his, alf, phy, lth (K-12)


Explores the question of what it means to create a "science for all" from the vantage point of urban homeless children. Describes the work of critical and feminist scholars on science and education as well as on teaching and research to question how inclusive the science education community is in its efforts to understand the margins of science for all.

chs, gen, eqt, bkg, ndf, sts (ALL)


Presents a study of ten-year-old students (n=531) from the U.S. and Germany that sought to determine the relationships between everyday experience, domain-specific control beliefs, acquisition of science knowledge, and solving of everyday technical problems. Presents a causal model, developed and tested through structural equation modeling, which shows that domain-specific out-of-school experience, mediated by control beliefs, only indirectly influenced problem-solving performance.

pbs, bkg, bfs, tec, chs (EL)


Analyzes the evolution of the French physics curricula and experiments from the beginning of the century to the present. Shows the strong coherence of the aspects of energy presented through teaching content and experiments.

cur, lab, phy, his, ped (SE)

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Presents characteristics of a learning environment drawn from a study of a grade 5 teacher. Analyzes the instructional activities presented to the students in order to explore the relationship between learning goals and conceptual change.

ccg, bkg, ped, kns (EL)


Argues that teachers need to be aware of the way students understand a conception and the way it is situated in their conceptual ecology in order to facilitate their negotiation of the scientific discourse.

ccg, ped, lrg, alf, tpd, cid (TE)


Explores the use of assessment to stimulate creativity and communication skills in engineering students. Describes full-scale studies for students in engineering, physics, computer science, and mathematics at two universities in Sweden. Discusses new examination methods, including continuous assessment, seminars, mini-conferences, oral presentations, written reports, and new ways of posing questions on finals.

asm, sks, ref, tec (ALL)


Investigates high school students' (n=13) changes in knowledge schema through interview and narrative data. Finds that the current theory influences gains in new knowledge and is closely linked to a capacity to apply higher order cognitive thought processes in constructing abstract knowledge.

kns, phe, cns, lrg, lth, ene (HS)


Reports the results of a questionnaire on teaching and facilities completed by teachers (n=214) and students (n=630) in Uganda. Indicates that teachers hold a view of science as problem solving while students see science as heavy with memorization.

ats, att, ped, bkg, nas, ref (SE)


Examines the potential benefits and existing barriers for preservice science teachers (n=22) engaging in an electronic professional community on the World Wide Web. Finds that the predominant barriers that preservice science teachers encounter when using the SciTeach forum appear to be a lack of adequate access to a networked computer and structuring time to engage in the web forum dialogue.

ntw, tec, tpd, bkg, cht (TE, PS)


Evaluates the ultimate goals of environmental and ecological education. Examines two versions of an established outdoor ecology program in a national park. Surveys students' (n=700) use of knowledge statements.

nfd, fsd, ene, cur, kns, asm (K-12)


Investigates 12th grade students' understandings of the nature of chemical bonds and the energetics elicited across five familiar chemical reactions following a course of instruction. Describes the many ways in which students can misconstrue concepts and principles.

alf, kns, che, lrg (SE)

Describes interviews with secondary science education majors in Singapore that took place after the students viewed five common chemical reactions. Explores reasons and remedies for the students' lack of scientific thinking ability.

**alf, kn, skt, che, pbs (TE, PS)**


Reports on the Quality University Elementary Science Teaching (QUEST) program. Explores changes in how teachers enable student conceptual understanding of science, how students modify their views of scientific inquiry during instruction, and how teachers value the use of technology in science instruction.

**tpd, tec, inq, ped (TE, EL)**


Focuses on monitoring a statewide systemic initiative (SSI) for reform of mathematics and science students through survey. Analyzes responses by race and gender. Finds that different types of teaching and learning activities occurred in classes taught by teachers who had participated in SSI's professional development.

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Describes interviews with secondary science education majors in Singapore that took place after the students viewed five common chemical reactions. Explores reasons and remedies for the students' lack of scientific thinking ability.

**alf, kn, skt, che, pbs (TE, PS)**


Describes the development and testing of Views on Science-Technology-Society (VOSTS) items for a group of 29 postgraduate trainee science teachers. Discusses findings as compared with those from the Canadian study, and reviews implications for the professional development of science teachers.

**att, sts, cul, tec, tpd (PS, TE)**


Focuses on how computers might help broaden assessment practices by examining the types of test items that might be used in computer environments. Explores ideas from cognitive psychology and research on problem solving.

**asm, cbi, che, pbs, kns (ALL)**


Explores an innovative approach to environmental science education by describing two experimental projects related to flooding in an Italian basin. Finds that cooperative production of the learning environment can be a way of re-evaluating the work performed by teachers.

**ene, cbi, cpl, mat, asm (K-12)**


Analyzes observations of primary students in a small Interactive Science Centre using a model of play, practice, and problem solving derived from a range of literature. Discusses salient features of the creative phase of the activities.

**nfd, pbs, hos, sks, ped (EL)**

Explores whether it is easier to achieve a higher level in the Key Stage 2 Student Assessment Tasks than in those for Key Stage 3. Reports the results of a study in which samples of both were given to two groups of pupils and finds that most obtained the same level in both or one level higher in the Key Stage 3.

ach, asm, sks, ref (K-12)


Investigates the role of second language issues as a barrier to adequate science education for underrepresented groups in science and engineering. Explores how current educational reform initiatives provide an opportunity for widespread change in how English Language Learners (ELL) learn science. Examines several model projects that attempt to provide innovative science education to linguistically diverse secondary students.

chs, ref, eqt, bkg, ped (SE)


Compares and contrasts the views of two people with interests in science education. Provides a stark and insightful contrast of the roles of scientists and engineers in precollege science education. Recommends that action be taken in addition to speeches about the issue.

ntw, cur, ref, ped (SE)


Describes the introduction of technology into the science curriculum and offers a general framework for analyzing technology as artifact, knowledge, and social practice. Provides analytical tools to study the implications of technology in general education.

cur, sts, tec, lit, nas (K-12)


Investigates the multiple uses and definitions of invention in science in order to develop a theory of invention and inventive acts around themes related to invention as a social act, invention as a recursive and socially linked process, and invention as an embodied agency.

his, sts, nas, phe (GEN)


Describes the construction of conceptual models of pressure and floatation using high school students' (n=314) previous ideas on these concepts expressed in an interview and in their answers to a questionnaire. Contends that these models allow the analysis of students' ideas about physical phenomena and recognize the inferential structure used by the students. Addresses the possible use of models in education.

alf, rem, kns, phy (HS)


Compares participants in a special program with a cohort of non-participants. Finds significant differences in high school graduation rates, completion of academic high school courses in science and mathematics, strong Scholastic Aptitude Test (SAT) performance, and college attendance.

ref, asm, car, ach, ped (SE)


Describes an approach to the instruction of science writing which includes both a collaboration between the librarian and the scientific writing teacher and the incorporation of ongoing and incremental
library instruction that is integrated with the writing assignments.


Explores how teacher participation in professional development activities impacts science instruction in middle school classrooms. Employs classroom observations and teacher interviews to examine the use of equitable teaching strategies.


Uses three case studies to examine philosophical and pedagogical issues surrounding the use of laptop computers in outdoor education. Describes the relationship between nature and technology and the use of computers in education. Calls for greater recognition of the value of field education, especially in science. Presents criteria for using laptops in field programs.


Investigates a taxonomy of seven proposed responses to anomalous data. Finds that one additional type of data is needed in the taxonomy. Suggests that the taxonomy can be used as a framework to guide classroom discussion.


Describes research conducted by a high school student in conjunction with her chemistry teacher that examined whether students who took reformed middle school science differed from students in regular science in grades, attitudes, and evaluation of science learning. Finds that students from the reformed program rated science significantly higher.

felt better prepared for high school, and planned to take more science courses.


Describes tendencies and difficulties experienced by students aged 14 through 17 years during an activity involving measurement in physics. Surveys these tendencies and difficulties through clinical interviews involving data collection, data processing, and data interpretation.


Evaluates the effects of the scaffold explanation-based approach to collaborative discussion on students’ understanding of photosynthesis. Finds that the average intervention (AI) students developed a more accurate scientific and functional understanding than the average control (AC) group.


Examines the cognitive development of students enrolled in three levels of freshman chemistry courses and focuses on changes in spatial ability over time. Finds that performance on general Piagetian-type tasks, including spatial visualization, can be refined through educational intervention. Concludes that students appear less prepared in formal thought than comparable students in the 1980s.


Reports on a survey of 129 science and technology-related centers and museums revealed a shortage of polymer chemistry exhibits. Describes those displays
that do exist and suggests possibilities for future displays and exhibits.

**nfd, che, sts, ref, mat (ALL)**


Presents a study using an electronic bulletin board as the software platform for students in a large second year college biology course to improve communications among students and between students and the instructor. Finds that the bulletin board was successful in fostering interaction between students as well as improving student-instructor interaction.

**cbi, ntw, ped, bio, cid (PS)**


Traces the evolution of physics teaching and research in Bucharest and Jassy, the two most important Romanian intellectual centers. Reports on three stages of historical development and includes selected biographies of Romanian scientists.

**his, phy, phe (GEN)**


Describes the Solutions model used at Shelley High School in Idaho, which gives students the opportunity to gain practical science experience while tackling community problems. Demonstrates how this approach is built on the three fundamentals of an integrated curriculum, a problem-solving focus, and service-based learning.

**cur, pbs, ped, int, fsd (SE)**


Reports on a study that investigates the effect of teachers' sociological understanding of science on their design and implementation of curriculum innovations.

**knt, cur, nas, phe, tpd, ped (K-12)**


Examines the effects of using concept maps in a physical science class for elementary science teachers on physical science achievement, self-efficacy, and anxiety toward learning and teaching physical science. Discusses implications for teacher education.

**att, rem, phy, ach, tpd, knt (TE)**


Presents a reflective account of a science teacher's endeavors to use the referent of critical constructivism to transform her pedagogical practices during a Year 10 bioethics unit taught at an independent girls' school.

**cns, ped, tpd, lrg, bio (SE, TE)**


Investigates the effectiveness of activities for students (n=506) in pre-university courses in Botswana and South Africa. Uses a cognitive conflict strategy to design learning activities to develop aspects of the Newtonian concept of force. Finds that the students' prior correct beliefs need to be identified as a basis for development of the scientific concept of force.

**alf, ped, cgg, phy (SE)**


Describes the implementation of a concept practical in a physics class. Uses the example of students predicting and testing what will happen to the speed and acceleration of a ball rolling down variously-sloped railings. Finds some evidence of conceptual development evident in pre- and post-test scores. Argues that a well-conducted class discussion is critical to the process.

**asm, kns, pbs, phy, sks (SE)**

Describes an interactive learning environment and characterizes students’ interactions with the system. Discusses a series of formative evaluations, which were crucial in the refinement of the system to make it an effective environment for teaching problem-solving skills to students at risk for academic failure.

*cbl, pbs, chs, bio, sks (K-12)*


Presents the results of a survey of British teachers on the use of games in science teaching. Findings indicate that if science games were more widely available, less expensive, and relevant to the National Curriculum, teachers would be more likely to use them as a teaching tool.

*mat, skt, ped, cur, ref (K-12)*


Investigates the problem-solving behavior of a university lecturer, doctoral students (n=2), master’s students (n=4), and first year undergraduates (n=6) by using think-aloud sessions, pen-and-paper problem solving, observations, and interviews. Finds that an understanding of fundamental aspects of expert problem solving can help inform novice structuring of, representation of, and access to knowledge.

*pbs, rem, lsy, phy, ped (PS, TE)*


Describes the relationships between instructor and student goals, course design, and student strategies for learning physics in a traditional introductory undergraduate physics course for nonmajors. Finds that diverse goals and the structure of the course inhibited the understanding of physics and were conducive to students engaging in unexpected behaviors designed to help them successfully pass the course.

*ats, cur, lsy, phy (PS)*


Focuses on how teachers understand the place of the laboratory and laboratory work in their practice. Bases findings on interviews conducted with secondary science teachers in England.

*cur, lab, att, sks (SE, TE)*


Provides educators with a baseline of approaches to environmental education for non-environmental engineering students. Explores the scope of environmental programs offered as special programs. Analyzes survey responses and makes suggestions for program implementation.

*ene, cur, tec, bkg, sts (PS)*


Examines explicitly whether students’ level of active participation and perceptions of male dominance in the science classrooms contribute to the gender difference in young adolescents’ perceptions of science ability. Finds that there is a trend for girls with higher ability perceptions at the start of the year to actively participate more in the hands-on activities and not to perceive boys as the dominant participants in the classroom.

*ats, gen, hos, cid (MS)*


Reports on the involvement of scientists in K-12 science education and their perception of science
education. Argues that findings should prove useful in determining how scientists might best contribute to science education in the future.

ntw, car, ref, cur (K-12)


Presents two pedagogical techniques designed to promote the development of a conceptual framework in general chemistry. Describes an exam reform which aims to turn exams into learning experiences for students, and the grouped laboratory essay approach in which students complete essays outside of class.

ped, asm, cpl, che, cur (PS)


Investigates how even a well-designed curriculum can lead students to construct an unwanted conception. Finds that the conceptual change cum discourse perspective has the potential to integrate the affordances of both methodological approaches and past empirical accomplishments.

cid, ccc, lth, cns, alf (SE)


Presents the outcome of a survey of student and qualified engineers (n=189) in Bulgaria. Finds a need for women to work for economic reasons and discusses the role of the communist system in emphasizing engineering and gender equity.

bkg, eqt, gen, tec, car (AD, K-12)


Examines and categorizes multicultural teaching information found in middle school science teacher resource manuals to determine how multicultural information relates to guidelines for teaching in multicultural classrooms.

mce, mat, cur, ref (MS, TE)


Examines the relationship of microcomputer simulation graphics and alphanumeric modes of data presentation to ninth-grade biology students' science process skills and conceptual understanding of selected science topics (n=64). Finds that the use of microcomputers and appropriate software can result in significant learning and understanding of genetics concepts and can enhance students' abilities to use specific process skills in problem-solving.

cbi, pbs, sks, kns, bio, lrg (SE)


Investigates the intuitive beliefs held by students (n=2326) about a number of well-known physical events. Finds that the context of the question has a clear effect on the frequency with which different options are selected in physically similar situations.

bfs, bkg, alf, phy, Isy (K-12)


Describes a two-year design experiment in which 6th and 7th grade science students designed hypermedia documents to be used by their classmates. Presents information on how teachers assisted with the longitudinal transitions in students' critical standards for judging research questions and evaluating the quality of hypermedia design.

cbi, mat, res, asm (MS)

Explores the processes by which female undergraduate students (n=91) make sense of their educational and career options and choices as they move through their education at a large Canadian university. Discusses implications for retaining more female students in the sciences.

gen, eqt, car, cur, ats (PS)


Hypothesizes that the structure of a teacher's oral discourse is a factor that influences student learning about the concept of chemical equilibrium. Sets out to establish the conceptual and discursive frameworks of three teachers.

cid, lrg, kn, che, chs (SE, TE)


Investigates Tasmanian students' (n=1,040) perceptions of the learning environment. Data were collected in the final stages of primary school and again in the initial term in secondary school. contends that first exposure to specialized science learning environments and teachers changed students' perceptions. Finds that both school size and student gender influenced factors in some learning environment dimension perceptions.

ats, bkg, gen (K-12)


Ascertains what people notice in the environment during hikes and whether this could influence environmental education. Identifies four themes: (1) the natural and physical environment; (2) trail aspects; (3) each hiker's physical and psychological preparedness and cognitive development; and (4) social aspects.

fsd, nfd, ene, lrg, cur (SE, PS)


Reports on preservice teachers' (n=69) use of a concept-mapping tool to create and modify concept maps about science-related curriculum content knowledge. Shows how the preservice teachers used the concept-mapping tool to construct their curriculum content knowledge in the form of more powerful integrated patterns. Finds that the process of concept map construction enhanced preservice teacher skills in planning instruction.

kn, cur, skt, tpd (PS, TE)


Presents the results of a study that elucidates children's developing powers of explanation as they relate to global warming and ozone depletion. Discusses the results using charts and provides questions from the instrument.

kns, lit, ene, sts (K-12)


Draws data from student responses to the Science Laboratory Environment Inventory (SLEI) and a curriculum analysis of the implemented laboratory tasks. Involves biology, chemistry, and physics students (n=387) in 20 classes in Tasmania, Australia.

lab, bkg, cur, phy, bio, che (SE)


Compares students' levels of participation during four different methods of teaching--cooperative learning, class discussions, concept maps, and
lectures—in a freshman-level general chemistry course. Finds that multiple modes of learning foster the metacognitive skills necessary for mastering general chemistry.

ped, cpl, lsy, che, ats, lrg (PS)


Investigates students' main difficulties in learning the concept of the electric field. Finds that most students, even university students, have ontological and epistemological difficulties using the idea of the electric field, thus preferring the use of reasoning based on the Newtonian model of action at a distance to solve problems.

kns, phe, phy, pbs, lrg (HS, PS)


Assesses beliefs about science and religion held by students (n=44), teachers (n=10), and clergy (n=4) in a Lutheran secondary school in Australia via a survey and interview. Finds that participants' views of the relationship between science and religious beliefs were complex. Contends that traditional science programs do not adequately address the range of student and teacher beliefs about science.

bfs, bkg, phe (SE, TE)


Investigates high school students' post-instructional knowledge of natural phenomena related to the concept of light flux as it applies to the seasons and to illumination. Describes didactic, cognitive, and ontological perspectives in relation to specific changes in the science curriculum.

cur, kns, phe, phy, ped, alf (SE)


Provides three different accounts of a gender equity project in a grade 10 science class. Describes different rhetorical forms for representing research and different assumptions about gender, equity, pedagogy, and the representation of data.

res, gen, phe, eqt, cns, bkg (K-12)


Emphasizes aspects of current thinking about environmental education within the international community. Discusses an inquiry into practice among secondary science teachers (n=81) in England.

att, ene, cur, sts, ref, knl (TE, SE)


Describes conceptualizations of learning orientations in beginning science teachers and how these orientations interact with the structure of teacher education programs.

lsy, knl, tpd (TE)


Presents a model of parent and teacher influences on the science attitudes of eighth grade students using data from the base year survey of the National Educational Longitudinal Study of 1988 (NELS: 88). Utilizes structural equation modeling methodology for analysis of categorical data.

bkg, ats, asm (MS)


Examines data on the attitudes of current physics students about their use of solutions to end-of-the-chapter problems in textbooks. Presents and analyzes students' responses about their actual use of the solutions, their reactions to the standard practice of restricted access, and their opinions about providing free access.

ats, pbs, ped, phy. att, cur (PS)

Assesses students' (n=128) reactions to altered circumstances for access to physics problem solutions. Finds that student reactions relate to various aspects of college-level education for adult learners, such as learner control, self-direction, participation, and self-confidence.

ats, lbs, ped, phy, cur, chs (PS)


Describes the development and implementation of an investigative laboratory class. Focusses on a new laboratory design that was determined by faculty, teaching assistants, and students. Includes a sample laboratory description.

lab, inq, ref, bio, ped (PS)


Reports on a two-year ethnographic study focusing on gender, science education, and the introduction of networked digital media for learning in middle schools. Presents how learners become active participants, exploring gender attitudes, when studying socio-scientific issues related to an endangered rain forest and using video, the Internet, and computer media.

gen, edt, ats, cbi, eqt, sts (MS)


Describes historical information on the incorporation of physics as a subject into secondary schools in Spain. Reviews religious and political tensions as early roadblocks to curriculum development.

blg, cur, his, phy, phe (SE)


Analyzes some of the ways in which human subjectivity and agency are constructed in the contemporary discourse of environmental education research. Finds that methods of constructivist science education research are not applicable to either subjects or subject matters of environmental education, and poststructuralist methodologies may provide useful frameworks for rethinking the ways in which human subjectivity and agency are deployed.

ene, cns, res, cur, phe (ALL)


Describes a project consisting of reanalyzing survey data showing Asian-American science and engineering majors to be less content with their undergraduate experiences and their field of study than other students. Questions whether Asian-Americans were really less content or whether their style of responding instead reflects a questionnaire item-type bias.

ats, eth, asm, tec (PS)


Describes an in-depth case study of teachers' use of image processing in biology, earth science, and physics classes in one high school science department. Explores issues surrounding technology implementation.

cur, ped, edt, cbi, inq (SE)


Describes British teenagers' (n=138) knowledge, perceptions, and attitudes toward biotechnology with particular reference to food production. Finds
that more than half the teenagers were familiar with the term "biotechnology," but most lacked detailed knowledge of the subject. Finds also that teenagers rated formal schooling in science as an important source of their current science knowledge and claimed to mistrust print media resources.

at,s, kns, bio, sts, mat, tec (SE)


Analyzes the responses of elementary school children (n=336) to an Awareness of Technology Survey question intended to explore how they would begin the technological problem solving process.

tec, kns, pbs, lth (EL)


Reports on the replication of a study of teaching styles from the 1970s. Explores possible relationships between class size and the quality of teaching in 60 classrooms. Suggests some reasons for teachers choosing teaching strategies that are ineffective.

bkg, ped, ref, tpd, ach (K-12)


Explores an attempt to determine if there were gender or age differences in the images that 11- to 16-year-old students have of scientists. Finds that as female students get older they adopt and project a more stereotypic image of scientists, whereas male students seem to harbor a less stereotypic image of scientists as they age.

car, nas, gen, ats (K-12)


Presents the epistemology of scientific concepts from a schematic modeling perspective. Discusses students' initial cognitive states based on the level of commensurability between students' own concepts and their scientific counterparts.

kns, phy, phe, lth (HS, PS)


Explores student views about knowing and learning physics along six conceptual dimensions via the Views About Sciences Survey (VASS). Finds that student profiles correlate significantly with physics achievement.

at,s, chs, ach, lrg, phy (ALL)


Investigates observations that teacher candidates majoring in elementary education exhibit a world view very different from teacher candidates majoring in a science discipline while obtaining teacher certification in elementary education.

bfs, chs, bkg, tpd (TE, EL)


Reports on a study in which upper-level elementary education majors (n=37) at an urban university participated in a cooperative controversy lesson. Finds that before the cooperative controversy lesson, 73% of the students felt that the nature of science was fact-based; however, after participating in the cooperative controversy exercise, 60% of the students felt that the nature of science was a combination of factual information and belief.

att, nas, sts, tpd, kn (TE, EL)


Analyses data from a longitudinal study of high school youth to test that involvement in sports often has a strong and positive association with young women's success in high school science. Describes both the functionalist and conflict theories regarding the purpose of sports.

gens, ach, bkg, chs (HS)

Describes a series of interviews with students at the end of their first year of studying science in secondary schools. Compares and contrasts students’ perceptions of reality with their expectations.

ats, bkg, phy, cur (SE)


Describes work done to provide staff of the Sandy Point Discovery Center with methods for evaluating exhibits and interpretive programming. Focuses on quantitative and qualitative evaluation measures designed to assess the program’s objective of estuary education. Uses pretest-posttest questionnaires and interviews to measure subjects’ knowledge and attitudes before and after a site visit.

asm, nfd, fsd, ene, ats, kns (EL)


Argues that community, field-based, service-oriented projects can be a powerful way to address concerns of scientific literacy. Recommends that an ethic of care and responsible action be an exemplar for schools and teachers, based on a case study of two ninth grade students.

fsd, sts, lit, cur, ats, ped (HS)


Investigates the relationship between subject matter and secondary science teacher identity, or sense of self. Develops a multidimensional model of identity and discusses the role of subject matter in the teachers’ descriptions of who they are. Provides implications of this relationship for science education reform and teacher education.

att, knl, tpd, ref, chs (TE, SE)


Describes the use of the Science Laboratory Environment Inventory (SLEI) which was designed for assessing senior science students’ perceptions of aspects of their laboratory learning environment. Explains ways in which SLEI has been used in research studies and outlines ways educators could use the instrument for evaluating aspects of their own science laboratory experiments.

lab, ats, res, asm, bkg, ped (PS)


Explores the influence of subject communities on the practice of secondary school teachers as they teach a new science and technology course that crosses traditional subject and department boundaries.

int, tec, tpd, knl, att, ped (TE, SE)


Examines the interrelations among student engagement, scientific thinking practices, and student role taking and social interaction in the context of 4th grade science lessons. Discusses findings in terms of the importance of combining guidance in the social as well as the intellectual norms associated with scientific thinking and discourse.

nas, ats, cid, ped, bkg (EL)


Challenges ways in which a positivist view of science has led to hegemonic discourse on writing to learn science and highlights contradictions in this discourse. Argues for pedagogy that draws on critical, feminist, and hegemonic pedagogies and incorporates affective, creative, critical, cognitive, and diverse language practices set within sociocultural contexts.

pbe, nas, ped, gen, lsy (SE)

Investigates the prevalence of various ideas among 16-19 year old students regarding the application of the rapidly expanding technology of genetic engineering to food production. Finds that more females were cautious about these foodstuffs than males.

kns, sts, bio, ats, gen, tec (SE)


Describes how a group of teachers sought to overcome the difficulties of major innovation by working with a change agent to critique their current practice, devise a more authentic school science, and implement their ideas.

ref, cur, tpd, hos, res, skt (SE)


Analyzes middle school students' interests in biology to provide information on instructional strategies and curriculum development in Korea. Finds that the highest interest domains are genetics and microscope observations.

cur, sts, bio, ped (MS)


Investigates the achievement of 10th grade biology students (n=82) who used computer assisted learning (CAL). Findings indicate that no significant gender differences in academic achievement were found within each group. Concludes that these computer simulations can be successfully integrated as short episodes in the existing biology curricula.

ach, cbi, gen, bio, cur, ped (HS)


Describes a tool that quantifies the number and kinds of interactions between students and teachers, based on the premise that structured observation of classroom events indicates whether a teacher is interacting equitably with each student in the...
classroom. Finds that both inservice and student teachers employed changes in teaching practice in response to the data.


Determines factors to predict success in college biology (i.e., prior knowledge of biology or reasoning ability) depending on the instructional method employed (i.e., expository or inquiry). Finds that reasoning ability accounts for a significant amount of variance in final examination scores, regardless of instructional method.


Reports on the findings of a three-year study that explored the development of children's concepts of evaporation at room temperature and condensation of atmospheric water vapor.


Investigates the development of children's conceptions of a substance and reports the findings in relation to children's understanding of boiling water and particle ideas. Argues that boiling water should have a broad significance in the curriculum.


Reports the results of an experiment in teaching strategies with undergraduates in a physics laboratory. Finds that preparation before a lab session improves student performance in the lab. Contends that follow-up work can lead to meaningful learning.


Investigates how science teachers' (n=14) knowledge of science and science pedagogy changed after participation in a constructivist-based methods course. Finds that within the zone of proximal development, peers, teachers' students, instructors, readings, and tools mediated knowledge development.


Describes a study of middle-level, performance-based science classrooms whose teachers were identified as being both exemplary hands-on science teachers and sensitive to increasing girls' participation in science. Finds that boys and girls did not participate equally in the classrooms, and that girls (but not boys) reported a decrease in science ability perception over the school year. Suggests that boys and girls experience the classrooms differently.


Examines the assumption that girls will benefit from performance-based or hands-on science classrooms by examining changes in students' attitudes toward science over the school year.

Investigates the benefits of introducing finite element methods into the curriculum of undergraduate courses. Analyzes the structure of the computer-assisted-design module and the extent to which it fulfills its main objectives. Discusses the efficiency of modern teaching and learning techniques used to develop skills for solving engineering problems and monitors the developing abilities of students tackling engineering problems.


Explores the methodological implications of sociocultural approaches to the study of scientific knowledge and practices. Reviews the history of the nature of science research to trace the methodological influence of science and technology studies upon science education.


Reviews literature related to gender, science discourse, and the discourse designed to enhance girls’ post-school options through exploration of nontraditional choices.


Explores the reasoning strategies of urban Year 6 students involved in creating their own questions and plans for scientific investigations. Emphasizes how students generate ideas for their own investigations.


Describes a study conducted in undergraduate science classes in Singapore using computer modeling and simulation. Reports that the use of computer models and simulations proved to be valuable in explaining many aspects of science. Finds that students felt that three-dimensional images helped them in their understanding.

Discusses whether knowledge learned in school has been integrated into students' everyday knowledge or just memorized. Examines the way the topics were covered in the textbook and taught in the classroom. Presents the results of student interviews soon after having been taught the topics as well as years later, to establish the impact of the teaching on their ability to define and explain concepts correctly.


Demonstrates that tutorial interaction can be structured so that peers can support each other's thinking and learning in science. Compares students who were assigned to one of three mutual peer-tutoring conditions.


Argues that discussing theories, including their origin, development and replacement by other theories, can help students understand both the objective and subjective aspects of the scientific process.


Investigates when students have difficulties in their first encounters with inquiry learning. Describes how students performed inquiry tasks. Finds that students were thoughtful in designing investigations and in planning procedures but failed to focus on the merit of generated questions, systematic experimentation, and discussion of the conclusions. Contends that teachers were central to the success of the inquiry.


Presents a survey and analysis of research related to the development of concepts of matter. Proposes that the clarity with which students understand the distinction between matter and objects influences their explanations.

Presents a study of the sanitary conditions of information technology classes and the capacities and health status of students studying information technology. Finds that students performed poorly in poor working conditions. Finds also that student health deteriorated and the number of students with myopia, poor posture, and scoliosis increased in number.

bkg, mat, chs, tec (HS)


Presents the argument that a social constructivist perspective can affect the design of teacher professional development programs. Provides an example of a South African training program in technology use for science teachers. Reports on teachers' related comments.

cns, edit, tpd, att, skt (TE)


Investigates links between organizational conditions and women's representation on college faculties. Finds that selective organizational contexts play a substantial role in representation, along with the female doctoral labor supply and political constraints.

bkg, eqt, gen, car (PS)


Explores the views of Japanese students concerning the nature of STS via a questionnaire. Discusses the results within the context of Japanese culture.

eth, bfs, sts, ats, nas (SE)


Presents the results of a study of themes in state science curriculum frameworks. Analyzes 25 state frameworks and finds that 88% of these emphasize the standard science and technology in society. Recommends an examination of educational policy links to state science frameworks.

cur, ref, sts, tec (K-12)


Describes ways in which the Women’s Institute, the largest and most influential women’s organization in the United Kingdom, attempts to fulfill its goal of creating an atmosphere in which its members can become more aware of the scientific and technological contexts of their lives.

lit, nfd, sts, gen (PS)


Reviews the history of the acquisition and refinement of the chemical arts in the context of the use of metals by humans, the academic-industry connection in chemical education, curriculum history in chemistry, and the state of the chemistry teaching and learning environment.

cur, his, che, ntw, ped, ref (SE, PS)


Investigates school children’s images of a scientist in Brazil, the United States, France, Italy, Chile, Mexico, India, and Nigeria by having them make drawings. Discusses the relationship between image and career choice.

car, cul, nas, ats (K-12)


Sheds light on views held by those who enjoy a certain degree of institutional legitimacy for talking about science either as practitioners in the field of science or as guidance counselors working with students interested in having science-related careers.

car, nas, att, bkg (K-12)

Responds to an article which advises risky practices that trouble traditional distinctions between science and non-science, and in particular argues to politicize science as a way to organize teaching. Raises questions about science as a regime of truth in a place where such questions carry much weight: the teaching of science to children.

nas, phe, ped, gen (SE)


Presents interviews of elementary school children who were questioned about how gears move on a gearboard and about work in commonplace machines. Finds that children’s reasoning became more general, formal, and mathematical as problem complexity increased, suggesting that mathematical forms of reasoning may develop when they provide a clear advantage over simple causal generalizations.

pbs, lrg, sks, kns (EL)


Summarizes a study evaluating state standards in science. Discusses the treatment of evolution, which varies tremendously in quality from state to state, at length. Highlights local political battles. Describes exemplary evolution curricula in Connecticut, Indiana, and other states.

evo, ref, cur, bio (K-12)


Reviews literature and discusses results of two national surveys that sought to identify factors influencing the participation of women and minorities in science and engineering. Contends that notions of self-concept/self-efficacy, peer influence, and goal commitment, which can be traced to early socialization experiences, may account for most participation disparities by race and gender. Finds that evidence is more limited for minorities than for women.

gen, eth, car, bkg, eqt, ats (HS, PS)


Critiques exhibits in London’s Science Museum in light of the problem of balance in presenting controversial issues in museum exhibits. Contends that while science museums claim to portray controversial issues in a neutral manner, neutrality is impossible. Asks how science museums can involve visitors in the controversy and how the museum’s role can be reconciled with commercial sponsorship.

nfd, ntw, sts, bio (ALL)


Reports on a study designed to determine whether the historical approach to chemistry teaching will promote the conceptual problem-solving ability of eighth-grade students and to identify whether high or low achievers profit more from this teaching approach.

ped, his, ach, pbs, cur, che (MS)


Applies digraphing methodology to a synthesis of research investigating the structural characteristics of students’ conceptions of natural phenomena. Finds that, based on phenomenography, students’ conceptions of natural phenomena (gravity, light, heat) were structured by the internal horizon, external horizon, and the interaction between these 2 horizons.

kns, lth, phy, lrg (ALL)


Explores whether there are problems with A-level biology that are broadly shared by teachers. Addresses five major areas of concerns: (1) teaching and learning; (2) practical work; (3) subject content; (4) assessment; and (5) initial teacher training.


Presents a model for developing theme-based, interdisciplinary, integrated curricula, which includes a theme creation phase and an activity refinement phase.


Adapts Cortes' Multicultural Empowerment Model to science teaching and to Wittrock's Model of Generative Learning and Teaching in Science. Argues that all children should be encouraged to learn science and learn about science.


Reports on a study of the views of teachers and staff on the introduction of individual investigative work into the pre-college, advanced-level chemistry courses in Great Britain.


Focuses on a curriculum development project involving a team of teachers and industrial technologists in the creation of lesson materials for secondary school science classes in Swaziland.


Examines in-service teachers' perceptions about two types of master's programs, a subject-specific master's program and an education-based master's program. Identifies the themes focusing on the benefits and detriment that in-service science teachers experienced within their respective programs. Describes the type of student that participates in each program, and suggests how master's programs could be better structured to meet the needs of science teachers.


Reviews research and practice related to science-technology-society (STS) instruction. Focuses on STS-related instruments that reveal teacher and student beliefs about STS issues and teacher actions that result from those beliefs.


Argues that neglecting the high percentages of neutral survey responses on some environmental issues may distort the picture of respondents' attitudes toward the environment and compromise valuable information on these issues.

Describes the progress made in Northern Ireland toward the introduction of GCSE science curricula in post-primary schools. Documents the move from separate courses in chemistry, physics, and biology to integrated science courses.

cur, int, ref. (SE)


Demonstrates ways in which science and science education can be arenas for liberatory pedagogical practices for a non-science feminist educator, when socioeconomic power relations can be challenged. Argues that the evolution and practice of scientific knowledge itself operates to exploit and oppress people everywhere in the name of a dominant class.

eqt, phe, nas, gen, eth, ped (SE)


Explores the environmental knowledge and attitudes of secondary teachers. Reveals that negative environmental attitudes are prevalent and that most of the teachers in the study have never attended any workshop or seminar on the teaching of the subject.

att, knt, ene, lit (SE)


Reviews types of environmental monitoring as well as the general aims of the organizations which sponsor volunteer monitoring programs for school and community groups. Describes how these programs address educators' interest in involving students in authentic science experiences and provide interdisciplinary activities that link schools and communities.

ntw, fsd, nfd, sts, ene (HS, AD)


Describes a study of concept map construction as a means of increasing the conceptual learning of first-year, non-major college chemistry students. Finds no significant differences between the control (essay-writing) and treatment (concept map-constructing) groups on post-lab multiple-choice achievement tests. Finds also that students indicated positive attitudes toward concept mapping.

ats, kms, ped. che, lrg (PS)

Mastropieri, Margo A.; Scruggs, Thomas E.; Mantzicopoulos, Panayota; Sturgeon, Amy; Goodwin, Laura; Chung, SuHsiang. (1998). "A place where living things affect and depend on each other": Qualitative and quantitative outcomes associated with inclusive science teaching. *Science Education,* 82(2), 163-179.

Describes the school factors associated with inclusive science instruction, and evaluates the classroom achievement of students with disabilities as compared to nondisabled students in the same class. Makes achievement and attitude comparisons between the classrooms. Finds that students in the activities/inclusion classroom demonstrated superior performance on content recall, higher level thinking, verbal elaboration, and affective measures.

chs, eqt, hos, sks, ach, ped (EL)


Draws attention to some contemporary educational issues that hinge upon interpretations of the nature of science, especially constructivist proposals. Discusses the range of philosophical debate on the merits of constructivism.

cns, nas, phe, ped, his (K-12)


Presents subset findings of a survey monitoring the flow of students from graduate studies through
postdoctoral positions and into permanent professional positions. Finds that the traditional career path continues to describe the first professional position for most, but not all, physiology Ph.D. recipients

car, ats (PS)


Describes how feminist pedagogy is concerned with transforming both how students learn science and the science curriculum that students are expected to learn. Argues that collaborative approaches (the dominant approach to reforming science education) serve to reproduce the dominant discourse of existing science systems. Contends that feminist pedagogy invites students to critically analyze existing scientific systems.

gen, ped, phe, ref, cur (SE)


Illustrates how a culture of collaboration may contribute to significant technological reform and foster conceptual change leading to distinctive pedagogy and praxis. Presents a case study exploring a collaborative effort between a teacher and a researcher.

ntw, edt, tpd, att, cgg, ped (ALL)


Reviews and evaluates the contribution of historical studies in science education with particular reference to the case of England and Wales, where a series of challenges threaten to undermine the enterprise as a whole.

his, cur, ref, lit (K-12)


Investigates variations in students' responses to lever problems across multiple assessment contexts and formats. Discusses various data sources, including students’ semantic maps, written responses to questions, and modeled solutions to practical problems.

kns, asm, pbs, lth, phy, alf (K-12)


Reports on an action research study of one male science education professor's experience teaching elementary science methods to females. Presents the perspectives of co-researchers and examines what each learned about the professor's practice.

att, tpd, gen, bkg, eqt, ped (TE)


Describes the development and implementation of an investigative laboratory class. Reports that the new laboratory design was determined to be a success by faculty, teaching assistants, and students. Includes a sample laboratory description.

lab, cur, inq, bio, ref, ped (PS)


Reports findings from the evaluation of the Global Learning and Observations to Benefit the Environment (GLOBE) Program. Examines issues concerning student-scientist partnerships such as benefits of the program to students and scientists, enhancement of authentic science in schools through technology, and the relationship between this program and other reform efforts.

ntw, ref, asm, hos, inq (K-12)


Describes research carried out with 4 student teachers of primary and secondary science
education. Analyzes and compares the preservice teachers' conceptions of the learning and teaching of science with their classroom practice when teaching science lessons.

att, lrg, ped, knt, tpd (TE)


Questions the phenomenon and the implications of being female in school science. Discusses several directions within teaching that interpret bell hooks' engaged pedagogy, which emphasizes a commitment to self-actualization and well being for both teacher and student.

gen, ped, phe, eqt; bkg (HS, PS)


Explores the factors that influence teachers to organize field trips. Describes a series of interviews conducted with secondary science educators. Finds that reasons for avoiding trips include discouragement from school administration, student behavior, and preparation of teaching materials.

fsd, ped, att, mat (SE)


Identifies four different types of science stories: (1) heroic; (2) discovery; (3) declarative; and (4) politically correct. Examines the philosophical assumptions that underpin heroic science stories. Considers the implications of these stories in the science classroom.

phe, his, cur, mat, ped (ALL)


Analyzes talk amongst students on videotaped recordings from a teaching sequence on the particle model of matter. Emphasizes the role of two types of discourse and the epistemological and ontological obstacles in the construction of scientific meanings in the classroom.

csn, cid, phe, lrg, kns (SE)


Examines the conceptual development of high school students' understanding of scientific research over a school year. Finds that students have uninformed notions of scientific questioning and have little experience with data analysis or communication of results.

nas, kns, res, sks, alf (SE)


Reports on student and faculty perceptions of group dynamics in problem-based learning situations. Finds that gender differences were demonstrated in interpretation of over half of the questionnaire items.

gen, pbs, cpl, cid (HE)


Describes a cooperative project in which students in a number of areas in Ireland collect environmental data for use by scientists working to solve real problems. Reports on the follow-up survey to the study.

fsd, ntw, res, hos, ene, nas (EL, SE)


Concludes that serious questions should be asked about the science education policy initiatives in South Africa. Cites the efficient and effective use of resources as the most important issue in the reform efforts.

ref, mat, cur (K-12)

Reports on a study in which a teacher used the collaborative development of a format-free computer database to facilitate knowledge construction in a group of three Year 6 students during a science project.

\textit{cbi, cpl, ped, kns (EL)}


Describes elementary school teachers' participation in a series of daylong workshops that involved hands-on, inquiry-based approaches to learning in formal and informal settings. Determines attitudinal change and teaching confidence levels through post-project questionnaires which were administered immediately and one year after the workshops.

\textit{hos, inq, tpd, nfd, att, ntw (TE, EL)}


Reports the establishment of links between Northern Ireland school science departments and other European schools through a special project. Finds that the benefits to teachers and students extend beyond the science curriculum.

\textit{ntw, ats, att, cur (SE)}


Explores stereotypes of scientists and the effectiveness of a national curriculum at altering these ideas among primary children. Confirms the prevalence of a gender-biased stereotype and an unrealistic view of students’ work.

\textit{nas, car, ats, gen (EL)}


Reports on a study that involves the analysis of twenty-three chemistry textbooks at the college freshman level to determine the degree to which they address developments in the history and philosophy of science.

\textit{mat, his, che, nas, asm (HE)}


Reports on a survey of elementary, middle, high school, and university science teachers. Finds that teacher education programs reflect little commitment to preparing or in-servicing science teachers to work effectively with students who have disabilities.

\textit{chs, eqt, tpd, cur, ped (TE)}


Focuses on the marginalized discourses that have arisen to oppose the racism, sexism, and classism espoused and advocated by mainstream science since its institutionalization up until the first half of the 20th century.

\textit{nas, eqt, phe, his (SE)}


Describes ways of eliciting teachers’ views on the nature of science, interpreting and understanding these views, and developing these views in the context of initial or in-service teacher education.

\textit{knt, nas, tpd, att, lrg (TE, K-12)}


Examines the effectiveness of two learning strategies, self-explanation and elaborative interrogation, for
the retention of scientific facts. Discusses the practicality and flexibility of each approach for university students.

\textit{Isy, kns. lrg (PS)}


Evaluates the effectiveness of an education program for tourists who hand-feed wild dolphins at Tangalooma, Moreton Island in eastern Australia. Finds that after the education program, inappropriate behaviors toward the dolphins were significantly reduced.

\textit{asfd, ene, fsd, sts (ALL)}


Explores the use of web virtual science museums in the classroom. Discusses the educational advantages of using virtual museums for both students and teachers. Contends that virtual museum visits can have comparable educational value to actual science museum field trips. Lists and examines sites which support classroom instruction.

\textit{cbl, nfd, ped, lrg (K-12)}


Explores conclusions from a series of seminars and open meetings held to review the future of science education. Addresses the successes and failures of science education, the science-education needs of students for lifelong learning in the next century, the possible form and structure of a suitable model for a science curriculum, and the problems with implementing such a curriculum.

\textit{ref, lit, cur, his (EL)}


Argues that a teacher's practice reflects changing experiences, knowledge, values, and identities, and as such can be productively thought of as a site for learning and for expounding upon what is known. Suggests a vision for what constitutes effective practice different from that commonly held in science.

\textit{knt, phe, tpd, ref (SE)}


Reports on a study of three dependent variables of household recycling behavior in a suburban community over 8 weeks, with 10 independent variables serving as predictors. Finds that many of the independent variables that predicted recycling behavior in past research have weaker relationships in current, more convenient curbside programs.

\textit{ene, nfd, sts (AD)}


Describes a project undertaken to increase the pedagogical content knowledge of Pakistani science and math teachers. Presents specific features of the Subject Specialist Teacher Programme in relation to both the contextual quality and relevance of the initiative. Addresses the challenges and possibilities associated with the model as a change agent.

\textit{knt, ped, tpd, ref (SE, TE)}

Describes the information technology (IT) capabilities of a group of science student teachers. Argues that using IT in the classroom is an essential component of a teacher training course and that progress is hampered by the infrequent use of computers by school mentors.


Investigates whether the introduction of the National Curriculum has had any significant effect on whether students enjoy science lessons, their perceptions of the importance of science, their attitudes toward practical and non-practical activities in lessons, and their views on how difficult science is to learn. Finds that the involvement of practical applications is the most significant factor in promoting positive attitudes.


Argues that a humanly-constructive critical theory of environmental education called 'a critical ecological ontology for educational inquiry' provides a necessary complement to the socially-critical perspective by focusing on our individual and collective being in the world. Explains that a critical ecological ontology highlights the personal political required for socio-ecological praxis. Discusses three practical applications of a critical ecological ontology that emerge.


Reports on a case study, situated within the context of the Technology Enhanced Secondary Science Instruction (TESSI) project, that examines the teaching and learning impact of technology from the perspective of students participating in a long-term study of technology implementation.


Examines children's developing understanding of the natural world via the designing, building, testing, and evaluation of models. Finds that students became engaged in investigating the relation between force and the location of the attachment point of the biceps. Contends that students' understanding of the relations between mathematics and science were developed through the construction and interpretation of data tables and graphs.


Describes the development of a problem-based learning (PBL) framework. Focuses on the development of preservice teachers' knowledge base for teaching and pedagogical reasoning ability.


Describes a year-long study conducted in 3 high school physics classes to provide empirical support for the existence of levels of language-rich teaching. Presents three levels (low, medium, and high) of language-rich teaching.


Draws data from an interview study of the perceptions of multidisciplinary education in health care. Suggests that multidisciplinary education is neither an easy nor a cheap option and that it requires careful planning.

Addresses the distinction between conceptual and algorithmic learning and clarifies what is meant by a “second-tier” student. Explores why novice learners in chemistry and physics are able to apply algorithms without significant conceptual understanding.


Reports on case studies of two undergraduates who showed how their level of skills, thinking, and teaching styles improved and expanded with the opportunity to practice what they acquired from their methods courses. Suggests that preservice teachers do better after they have had an opportunity to practice educational theory.


Describes Project LIFE, a state systemic initiatives professional development program for middle-grade science teachers. Finds the project has been successful in improving the science content knowledge, process skills, and attitudes toward teaching science of the teachers participating in the project. Gives the essential characteristics of this project as a guide for individuals planning or delivering reform-based science education professional development.


Reports on a model of environmental education that aims to encourage greater attachment to the bioregion of Arcadia. Explains how the model results from cooperation within a village community and addresses the environmental education of people of all ages.


Reviews research on children’s ideas about floating and sinking. Describes the Model-Assisted Reasoning in Science (MARS) project curriculum and student responses to a question about helium balloons.


Finds significant positive correlations between teacher supply in one or more science subjects and the existence of a broad field science endorsement, the number of hours of science required for a broad field science endorsement, and the number of subjects covered by a broad field science endorsement.


Addresses the distinction between conceptual and algorithmic learning and clarifies what is meant by a “second-tier” student. Explores why novice learners in chemistry and physics are able to apply algorithms without significant conceptual understanding.


Examines the impact of the MARS curriculum mass unit. Describes classroom observations, examination of students’ written work, and analysis of protocol data from interviews conducted at the end of each of the three main sections of the curriculum.

Presents answers to a survey on the state of science education for 11-16 year-olds in the United Kingdom. Describes findings on various topics including class size, per pupil expenditure, extent of laboratory technician support, textbook provision, condition of laboratory facilities, reprographics costs, and technology use.

bkg, mat, (SE)


Analyzes Estonian teacher interviews and student responses to open-ended questions about lessons created to promote scientific and technological literacy (STL) on process, attitudinal, and instructional domains.

ats, att, lit, ped, cur, sts (SE)


Examines didactic strategies used for introducing preschoolers to the natural sciences. Describes general characteristics of activities based on empiricist or Piagetian theory of cognitive development. Discusses a new sociocognitive approach for developing natural-science kindergarten activities within the framework of Neo-Piagetian, socioconstructive, and Vygotskian theories.

lth, ped, cns, bkg , hos (EL)


Analyzes the ways in which some school science textbooks used with 14-16 year olds in Great Britain portray the topic of human sexuality. Finds that the 15 books examined vary greatly in their approach to the topic.

cur, mat, bio, sts (K-12)


Discusses a 1997 symposium, during which speakers raised three issues about gender equity and research: (1) the distinction between the meanings of the terms 'gender' and 'sex;' (2) assuring that science methods classes are gender inclusive; and (3) determining the reasons for changing practice.

eqt, gen, res, tpd, ped (ALL)


Reports on research that aimed to establish whether patterns of students' reactions to and achievement on physics assessment tasks were associated with the format of the task and the absence or presence of real world contexts in the tasks.

ach, asm, eqt, phy (ALL)


Argues that role-playing activities can be a powerful technique in mathematics and science education, particularly in the study of the new sciences of complexity. Detailed descriptions and analyses of two role-playing activities are presented.

ped, lrg, rem, (ALL)


Reports on a year-long study implemented in grade 7 life science classes with the students' regular teacher serving as a teacher researcher. Suggests that concept mapping may be useful in assessing declarative and procedural knowledge.

asm, kns, rem, bio (SE)

Shares assignments developed and used by feminist science and teacher educators in undergraduate and graduate teacher education classes. Focuses on students' reactions to these assignments.

att, gen, eqt, tpd, ped (TE)


Summarizes the process of a reform effort in biology instruction. Describes the use of a case study about cholera epidemics and explains how it enables critical objectives in the science curriculum to be addressed.

bio, ped, ref, cur (K-12)


Speculates about the experiences that contribute to the overall development and preparation of a scientist and whether educators can recreate this process to support the development of all students.

ntw, car, nas, bkg (SE, PS)


Examines the interest level of Chilean students in physics and technology in light of unacceptable performance levels in these areas. Finds that relevant thermodynamics problems applicable to students' daily lives generated more interest. Discusses the importance of presentation to student acceptance of the curriculum.

ats, pbs, ped, phy (K-12)


Studies a teacher's role and actions in a science learning community. Interprets two teaching episodes that illustrate how the teacher helps a group of students transform their understanding of electrical circuits.

ped, cns, lrg, phy, cid (K-12)


Interprets student teachers' responses to open-ended interview probes concerning the relationship of humans to the nonhuman natural world. Supports the argument for incorporating students' eco-philosophies into instruction in environmental education.

ene, phe, tpd, knt, att (SE, PS)


Presents a phenomenological study of student experience in a computer conference learning environment. Suggests that issues for students in conferences revolved around spatial disorientation. Finds that students grappled with getting into a computer space, familiarity of use, getting stuck, and the class as a necessary evil within spatial issues.

cbi, ats, sks, sts (PS)


Argues that visual images can act as conceptual pegs for concepts or complicated procedures and help students perform better in the cognitive, affective, and manipulative domains of the laboratory. Bases conclusions on a study of chemistry laboratory students.

lab, rem, ped, lrg, res, che (HS,PS)


Reports on two types of resistance by preservice science teachers, resistance to ideological change and resistance to pedagogical change. Suggests a sociotransformative constructivist orientation as a vehicle to link multicultural and socioconstructivist theoretical frameworks.

att, cns, mce, eqt, ped, tpd (TE)

Describes a math and science summer program for high-achieving middle school girls. Covers the organization, curriculum, instruction, and outcomes of the program and describes elements that students rated favorably and those which needed to be changed for the second summer.

nf, gen, fsd, ats, cur (MS)


Presents a case study that explores the ways in which a beginning elementary classroom teacher started to gain proficiency in teaching science. Examines the teacher’s experiences learning science in an educational research project and her work in the classroom to bring her students’ ideas into contact with accepted scientific ideas and practices. Explores an approach to professional development that engages teachers in learning and viewing science as a socially and historically constituted sense-making practice.

att, nas, tspd, ped, skt, phe (EL, TE)


Compares a school that integrated mathematics, science, and technology in grade 9 to a school in the same district that taught the same courses separately. Discusses the benefits of an integrated learning setting for the students.

int, ref, ped, tec, cur, lrg (SE)


Asks whether teachers are prepared to teach inquiry with the associated transformation and analysis of data. Investigates the extent to which future secondary teachers employ inscriptions in the analysis of a problem in ecology and the nature of the written arguments they provide in support of their answers.

pbs, inq, rem, tspd, ped, ene (TE, SE)


Provides a framework for and a guide to the multiple links between the ten articles in this special journal issue that address science and technology and science education. Argues for creating a more accurate image of science.

his, phe, nas, res, sts (ALL)


Discusses how scientific knowledge emerges from the social, natural, political, cultural, historical, and economic contingencies of scientific work. Illustrates the advantages of familiarity with research in science and technology.

phe, nas, res, his, ped (ALL)


Analyzes assessment data gathered in a study of knowing and learning in a mixed classroom, in which a unit on simple machines was taught according to a conception of learning by participation in open-ended design activities. Proposes a framework for understanding variations in cognitive performance across situations.

asm, lth, ped, phy (MS)


Investigates what two teachers learned from each other as they engaged in co-teaching an engineering curriculum. Argues that co-teaching afforded experiences that have been shown to arise from co-participation in other domains. Finds that science content and content pedagogical knowledge fully

Develops an analytical framework in which inscription (i.e., grades) and actor networks are the central points. Gives an example of this framework in a case study of grades and grading practices. Shows how the framework can be used to provide constructive poststructuralist analyses and how the efforts of critical and liberation pedagogies are undercut by the stability of existing networks.


Reports on a small-scale investigation of student understanding of moments of forces to provide some indication as to the nature of intuitive ideas in this area. Finds three stumbling blocks in the conceptual understanding of moment of forces.


Examines how the theory of evolution was received by the scientific community at the time of its inception in order to provide insight into some of the difficulties that students have in learning important biological concepts.


Investigates the effectiveness of two different types of interviews: one that embeds a concept map, and one that does not embed a concept map in order to elicit post-instructional understandings. Focuses on students' understandings of chlorofluorocarbons and their role in global atmospheric change.


Reports on a study that uses psychometric modeling to rank the appeal of a variety of children's styles from the 1970s. Explores possible relationships between class size and the quality of teaching in 60 classrooms. Suggests some reasons why teachers choose teaching strategies that are ineffective.
astronomical ideas on a single uniform scale. Supports the view that alternative conceptions may be markers of progress toward understanding.


Characterizes the methodology of case studies, using examples from science education, with regard to their potential for the analysis of innovation and formulation of emerging trends. Argues that the theoretical and empirical support for evaluation will generate a call for negotiation as the formula that regulates the assessment of a program's efficiency and usefulness.


Discusses ideas for narrowing the gap between intent and performance when students are taught about environmental issues. Alleges that environmental bias is common in the teaching of environmental issues.


Examines female students' work constructed in the science classroom and how their science lessons relate to the construction(s) of their school careers. Uses a sociocultural approach to learning to focus on the students' activities, their interactions with peers and the teacher, and artifacts of science. Finds that differences in the students' grades and classroom social networks seem to be closely mirrored in the classroom interaction. Suggests that an understanding of science learning in education benefits from considering the different situations and strategies of different students.


Discusses the approaches taken to integrating teaching of basic sciences, clinical sciences, and biopsychosocial issues by eight medical schools participating in a large-scale curriculum development project. Addresses the problems encountered, resources needed to support interdisciplinary courses, benefits of integration, and lessons learned.

Sandor, M. Kay; Clark, Michele; Campbell, Doris; Rains, Anna P.; Cascio, Rita. (1998). Evaluating critical thinking skills in a scenario-based community health course. Journal of Community Health Nursing, 15(1), 21-29.

Discusses the influence of a scenario-based community health course on the ability of senior nursing students to address complex problems seen in the community health setting. Finds that improvements were made on the Interpretation and Evaluation subscales and on the total critical thinking score from pretest to posttest for students who completed the course. Finds also that students who completed nursing prerequisites in midsize, 4-yr universities had higher pretest mean score than did other students.


Finds that at that time of entry, women and U.S. minority graduate students in science and engineering have academic credentials and expectations similar to those of their Anglo male peers. Discusses student perceptions of academic preparedness, status-related disadvantages, and expectations about student-faculty interactions as significant predictors for academic self-efficacy and career-related outcomes expectations.


Discusses some results of the TIMSS and responds to criticisms of that study.

Explores issues of gender and personal life that arose during discussions with women scientists about factors contributing to their success in completing training and pursuing an academic career. Describes such issues as gender discrimination, perception of reverse discrimination, efforts toward assisting junior women in science, and the possibility that women practice science in a different manner than male colleagues.

eqt, gen, car, ntw, nas (PS)


Discusses a survey of preservice elementary teachers meant to determine the extent to which they held certain alternative conceptions of science and to determine the relationship between science teaching efficacy and the holding of specific alternative conceptions. Finds that certain alternative conceptions were related to self efficacy.

alf, ats, nas, knt (TE, EL)


Uses a theoretical framework derived from Vygotsky’s writings to review studies of science classroom discourse interactions between teachers and students. Suggests that shifting the research focus from isolated instructional activities to promote conceptual change toward viewing such activities in the critically influential context of an ongoing flow of discourse could greatly inform teaching practices.

ccg, cid, cns, ped, lth (K-12)


Summarizes recent findings of empirical research in science education concerning students with disabilities. Discusses learning characteristics of disabled students, effective instructional strategies including text-based interventions and inquiry-oriented interventions, and inclusion practices.

chs, ped, mat, hos, inq, res (K-12)


Reflects on how physics and physics education in Slovakia has been influenced by totalitarian social organization. Focuses on two historical periods, 1939-1945 and 1948-1949.

phy, his, nas, phe, sts (GEN)


Addresses two research questions pertaining to the search for students’ potential alternate conceptions within the history of science and the possibility of helping students overcome these misconceptions through historical experiments.

ccg, his, alf, ped, phy (HS)


Explores the reasons behind student-held images of science and scientists. Finds that male students were more strongly influenced by public stereotypes of science and scientists at a younger age compared with female students. Demonstrates that parents, peers, and teachers have an impact on students’ science-related career choices.

bfs, gen, nas, ats (EL)


Presents a study of freshman biomedical science students exposed to a problem-based learning curriculum. Describes student attitudes and performance following instruction as compared to previous years under traditional instruction.

ats, ped, pbs, cur, hos (PS)

Describes a study designed to assess students’ understanding and acceptance of the credibility of the scientific evidence supporting evolution. Discusses results and implications and offers advice to professors on how to ameliorate the divisiveness resulting from this controversy.

evo, bfs, alf, bio, nas, rpd (PS)


Explains a taxonomy of basic skills of science practicals that is used in the assessment of secondary science students. Details the assessment scheme, which involves the evaluation of students through laboratory practical examinations, observational assessment, and written records of academic sessions.

asm, lab, sks, pbs (SE)


Investigates the effectiveness of the Stanford Faculty Development program of nine small-group seminars designed to provide teachers with a framework for analyzing teaching and identifying areas for improvement and to provide training in specific teaching skills. Finds that the program has significant potential for enhancing teaching effectiveness of basic science instructors.

ped, tpd, skt, ref, car (PS, TE)


Identifies those aspects of family support that have the most influence on students’ learning in mathematics and science. Examines the relationship of the mother’s support and participation to the eighth-grade minority child’s score on standardized tests.

bkg, ach, eth, (MS)


Challenges the accepted American view that the modern undergraduate student takes longer to graduate than the traditional four years. Evaluates a 10-year record of geoscience students who graduated from three programs.

chs, esg, car, (PS)


Analyzes the effectiveness of a constructivist-historical teaching strategy in changing students’ misconceptions about the earth’s shape and gravity. Describes the impact of the treatment on students’ understanding of the earth’s shape and gravity concepts.

alf, cns, his, esg, kns, ped (EL, MS)


Summarizes research into how children perceive three-dimensional objects. Focuses on the difficulty that students have in appreciating how the orientation of the semicircular canals affects balance and space perception.

rem, sks, lrg, bio, res (SE, PS)


Analyzes the structure and skill level of the tasks in the practical activities prescribed in process-oriented integrated science textbooks for Caribbean pupils. Finds that most of the tasks are structured and deductive in approach with an emphasis on low-level inquiry skills. Suggests that it is doubtful that the tasks increase students’ ability to carry out open-ended scientific investigations.

mat, sks, int, inq (SE)

Compares Reform of Secondary Education (ROSE) students' and non-ROSE students' perceptions of five psychosocial dimensions of their science practical tasks, including student cohesiveness, open-endedness, integration, rule clarity, and material environment. 

ats, cur, pbs, bkg, sks (SE)


Reports on a study of children aged 10-11 years exploring forces. Reveals a gap between the ways that measurement is used in mathematics and the ways it is used in science. Reviews the focus of the National Numeracy Project.

int, lit, cur, lrg (EL, PS)


Discusses how to promote scientific and technological literacy within a science methods course. Describes the rationale for the design of the course, the structure of the course, prospective students, the types of technological tools, the integration of those tools into the course with examples of student-constructed artifacts, and challenges experienced throughout the course.

edt, lit, tpd, inq, skt (TE)


Describes how constructivist-based discussions in the science classroom were elicited through the application of an intervention model for effective whole-class discussion based on the “Philosophy for Children” program. Finds that the experimental class experienced significantly greater gains in scientific reasoning than the control group. Contends that the discussion transcripts support theoretical accounts of how scientific reasoning improvement occurs.

cns, cid, pbs, ped (MS)


Uses data from a survey of Perth lower secondary science teachers to determine the nature of the laboratory work undertaken by their students. Finds low levels of inquiry learning.

inq, cur, lab, att, ref (SE)


Responds to critics of constructivism and asserts that constructivism is a sound theory that explains the practice of science and science pedagogy. Offers a constructivist account of some long-standing epistemological issues.

cns, ped, nas, phe (K-12)


Compares male and female perceptions of and confidence in an experimental physics class at the University of Arkansas. Finds that women made statistically significant gains in confidence and attitude toward science in the experimental course compared with students in a traditional course.

ats, gen, cur, phy, ped (PS)


Considers differences in ability and attitude toward physics still remaining between males and females who had made a positive decision to study the subject beyond the compulsory minimum level. Finds that gender differences were still apparent.

ats, gen, phy, car (SE)


Examines the process that one instructor of undergraduate introductory science underwent when she attempted to execute constructivist teaching into practice. Explains how the instructor met the four criteria for conceptual change. Gives recommendations for facilitating pedagogical conceptual change into constructivist college science teaching practices.

ccg, cns, ped, lrg, ref (PS, TE)

Describes a study of six 12-year-old students who were followed during an eight-month course using "Energy and Change" curricular materials, which introduce ideas related to the Second Law of Thermodynamics through an abstract picture language. Concludes that students had higher levels of generalization in their explanations of physical, chemical and biological change. Proposes that teachers should be instructed in the use of these project materials.

rem, mat, kns, lrg, cur (MS)


Analyzes the perceptions of students, teachers, and external observers in order to study the influence of classroom environment on the implementation of an innovative project in science education.

ats, att, bkg, cur, ref (HS)


Reports about the preconceptions of efficiency displayed by six primary school teachers, and the ways in which these became more scientific following in-service training. Suggests that ideas about energy efficiency (a scientific concept) need to be taught explicitly and distinguished from energy conservation.

att, skt, tpd, (EL)


Explores gender and racial differences on two science alternative assessments, an open-ended paper-and-pencil assessment and a hands-on performance assessment. Notes significant differences in achievement.

asm, cul, gen, (EL,SE)


Reports on a comparison of intuitive knowledge and definitional knowledge for students using computer simulations with model progression and assignments of small exercises. Finds a small gain in definitional knowledge for three tested conditions. Finds also that the gain in intuitive knowledge was considerable and differed across the experimental groups in favor of the conditions in which assignments and/or model progression were present.

cbi, edt, kns, phy (HS)


Argues that many students of chemistry demonstrate alternative conceptions about some fundamental aspects of chemistry. Suggests that research evidence provides strong support for this view.

ccg, che, res, (PS)


Explores the use of an impact evaluation model across time and clientele groups that is used to evaluate exhibits from two science centers in Manila. Finds that students prefer exhibits that produce sound, light, and motion.

ats, nfd, res, (EL,SE)


Investigates how Israeli junior high school science teachers perceived and implemented the science curriculum in 1994-95. Reports on teachers' job characteristics, perceived constraints, professional
activities, perceptions of preparedness and readiness to deliver the curriculum, instructional strategies, views on science learning, educational goals, and assessment strategies.


Presents the results of an international comparative study into the status of environmental education. Concludes that the current provisions for environmental education for primary children in Nigeria are insufficient for the development of national programs.

cul, ene., cur (EL)


Explores students' conceptions of the relationships among 31 environmental issues using multidimensional scaling analysis. Suggests that both male and female Grade 5 subjects develop meaningful conceptions of relationships among issues which have personal relevance to them.

ene, sts, rem (EL)


Studies the role of intuitive rules in science and mathematics education. Describes the effect of two intuitive rules on students in grades 7-12 as they perform tasks related to mathematical and physical objects.

int, pbs, lsy (SE)


Discusses the results of a four-year study of the conceptions of energy held by science teachers in training. Concludes that the group held a number of different alternative conceptual frameworks.

bfs, tpd, (SE, PS)


Explores the interaction between scientific epistemological beliefs and learning orientations in a group of Taiwanese eighth grade students. Suggests the importance of employing a constructivist philosophy in the classroom.

cns, phe, rem, ats (MS)


Proposes a simple predictive model for multistep problems and compares the model's predictions with actual data. Examines mechanisms that may block the solution or lead to violation of the model.

lth, pbs, rem, lrg (SE)


Explores the responses of primary school groups to animal exhibits. Suggests more similarities than differences by gender.

ats, bio, gen, cns (EL)


Concludes that differences in performance on the TIMSS at different grade levels are due to unfocused curriculum, a static conception of basics, dispersed control, and splintered versus integrated reform.

cul, cur, ref, (EL)

Outlines Vygotsky's distinction between everyday and scientific concepts in education, and traces what happens to everyday concepts once a child enters school. Argues that Vygotsky's distinction was plausible and fruitful, but that it was problematic in its details and its application in actual schooling. Claims that Vygotsky's legacy can be criticized on both theoretical and empirical grounds, and urges Vygotskians to continue this process.

cns, his, alf (GEN)


Describes an empirical study concerning the introduction of the concept of chemical equilibrium in chemistry classrooms in a way which challenges students' initial conceptions of chemical reactions.

crg, che, ped (SE)


Relates the reasoning of students introduced to the concept of chemical equilibrium to the historical development of the concept. Concludes that the study of authentic historical sources may inspire the design of effective teaching activities.

che, his, ped (SE)


Discusses the concept of pedagogical content knowledge within the context of science teaching. Defines the concept and identifies teaching experience as the major source of pedagogical content knowledge.

knt, ped, rem (TE)


Describes a study of changes in students' conceptions of genes during genetics instruction. Finds that, ontologically, most students moved from passive to active models of genes. Argues that, affectively, students were interested in genetics but unmotivated by microscopic mechanistic explanations; however, teaching approaches were simplistic. Contains that, epistemologically, most students held intelligible or plausible--but not fruitful--conceptions.

alf, cgg, phe, bio, lrg (HS)

Suggests that the results of TIMSS rank Western Australia as first in the world in science. Examines a statewide curriculum reform initiative that focuses on primary level science teacher leaders.

cul, cur, tpd, ref (EL)


Describes what happens when two lead teachers in a statewide reform project try to change science teaching in their schools. Illustrates the importance of patience in reform implementation and the need for sensitive study of early change within school contexts.

att, ref, bkg (K-12, TE)


Investigates the role played by two types of textual changes -- those aimed at improving the relationships within text ideas, and those aimed at producing better links between text ideas and the reader's knowledge -- on shallow and deep levels of comprehension. Finds that main idea performance was affected by improving the relationships within text ideas, both textual changes contributed separately to recall, and problem solving increased only when the two changes were presented together.

sks, pbs, mat, lrg (HS)


Finds that Botswana junior-level science teachers reported mediocre performance for socioeconomic developmental functions over the past decade when surveyed concerning their views on science education's development functions. Argues that the system seems to work well at combating the HIV/AIDS virus, preparing students for further study, and instilling some environmental awareness, but less well at preparing young people for self-employment.

att, sts, bkg, car (SE)


Uses a hermeneutic phenomenological research perspective to analyze the teaching journal of a first year chemistry teacher: Describes the process of creating a professional identity for the science teacher through examination of three dilemmas the teacher experienced, the metaphors she created, and the identity she constructed.

att, tpd, skt, che (TE)


Describes a theoretical framework for science education based on cognitive/developmental research. Argues that science learning is a gradual process during which initial conceptual structures based on children's everyday experiences are continually restructured.

lit, cgg, alf, kns (K-12)


Compares the achievement in science for ninth grade students in China and the United States. Reveals a small difference between the two groups and presents a rationale for the comparison.

cul, ach, asm, cur, lit (HS)


Describes a study of three suburban schools that sought to understand the science classroom environment and to propose changes in methodology.

ccg, cid, ped, hos (ALL)
Comments on the fact that conditional equity metrics report differences in performance among groups of students given one or more conditions under which that performance may have been influenced. Discusses their use as a tool for evaluating equity.

cqt, ref, res, asm (ALL)


Argues that science educators often face the problem of non-normal distributions when conducting large-scale assessments or evaluating national curriculum projects that require complex sampling plans. Examines the precision of science test scores.

res, asm, ach, cur (K-12)


Reports on the instructional trials of the ThinkerTools Inquiry curriculum by teachers in urban classrooms. Describes the curriculum, which centers around a metacognitive model of research called the Inquiry Cycle, and a metacognitive process of student reflection called Reflective Assessment.

asm, cur, inq, sks, res, lrg (SE)


Presents teacher perspectives of the impact of Internet usage on their teaching practices. Uses semi-structured interviews and two online surveys to provide data from teacher participants in the West Virginia K-12 RuralNet Project.

att, edt, ped, (ALL)


Compares geographic membership patterns for three national environmental organizations to determine if similar membership patterns exist for different types of environmental organizations. Finds strong similarities in the spatial patterns of membership among the groups. Concludes that all three organizations had higher membership ratios in northeastern, western, and Rocky Mountain states and lower ratios in the Midwest and South.

e, nfd, (AD)


Analyzes differences in the status of ontological categories on the concept maps of secondary-, undergraduate- and graduate-level chemistry students with the "Pathfinder" scaling algorithm and multidimensional scaling. Finds differences among groups in the structural significance of abstract process-related nodes and matter-related nodes on the topic of acid-base equilibria. Discusses implications for theories of conceptual change.

rem, kns, ccg, che, lth (SE, PS)


Investigates the effects of a constructivist versus objectivist learning environment on college students' conceptual change using a computer simulation of the human cardiovascular system as an instructional tool.

ccg, cns, cbi, phe, kns (PS)


Reports on a study that explores student perspectives on the transfer to A-level chemistry from GCSE
chemistry. Explores the attitudes of groups of new A-level chemistry students at a sixth-form college.

Winstlow, Joseph; Smith, Doug. (1998). Virtual interns in the field: Pre-service educators as online mentors to at-risk middle school science students. Electronic Journal of Science Education, 3(2).

Describes an exploratory study in which undergraduate education majors mentored at-risk middle school science students using real-time (synchronous) chat technology. Describes the program, in which mentors and mentees met in web-based chat rooms three times a week for six weeks to discuss concepts relevant to the science curricula.


Presents a study of the merits and the limitations of an assessment method based on an intentional perspective and implemented in an inclusive educational program at the tertiary level of university education. Describes how an interdisciplinary assessment procedure can promote critical reflection on the ways in which a subject matter is perceived in different disciplines and academic genres.


Examines whether children had adopted negative perceptions of science at the time that they left primary school, and whether the introduction of the National Curriculum in England and Wales in 1989 influenced students’ attitudes.


Examines the interaction of two contrasting epistemological treatments of science in a high school physics class and the subsequent classroom management techniques influenced by these beliefs. Identifies a range of epistemological commitments found during surveys, interviews, and observations of a physics teacher and his students.


Examines the level of environmental consciousness of students in an educational system where curriculum objectives are shaped by public examinations. Finds that respondents have only
a limited understanding of environmental issues, especially in regard to objectives like synthesis and evaluation.


Probes certificate-level students' understanding of the menstrual cycle by analyzing their performance on a multiple-choice item in a public examination. Finds that many students showed problems in relating the time of conception to the condition of the uterine lining. Suggests that conceptual development can be promoted by classroom instruction that avoids excessive factual detail, establishes meaningful connections between new and existing concepts, and takes into account students' prior knowledge.


Uses an instrument designed to identify misconceptions in biology to reveal that novice biology teachers hold a number of conceptual errors which are also prevalent among secondary science students.


Assesses the subject matter competence in physics of inservice junior secondary science teachers in Hong Kong. Concludes that teachers lack subject area knowledge. Discusses general implications for educational improvement.


Seeks to develop and verify the Index of Science Reading Awareness (ISRA) based on a model of an efficient, successful interactive-constructive science reader and three independent metacognitive awareness domains. Finds no support for the assumption about the three independent metacognitive awareness domains and also finds that students have surface knowledge about science reading, science text, and science reading strategies.


Explores the relative effects of cooperation with and without inter-group competition on Taiwanese students' academic achievement in science and their attitudes toward science in a computer-assisted instruction environment.


Discerns high school teachers' perceptions of and commitment to the contemporary goals of science education. Suggests that a minority of teachers hold past goal orientations and that secondary science teachers are moving to embrace current goals.


Investigates the scope and nature of tasks demanding students' application of higher order thinking skills while studying biology in junior and senior high schools in Israel.


Relates stories told by science supervisors about a novice science teacher each had supervised. Analyzes the metaphorical statements the
supervisors made about teachers and teaching. 
Concludes that autobiographical stories can be used
to communicate values about teaching.

cht, tpd, res (TE)
Journals Searched

The number of science education research articles indexed from each journal is indicated in parentheses.

- Academic Medicine (2)
- Alternatives Journal (1)
- American Biology Teacher (2)
- American Educational Research Journal (1)
- Applied Developmental Science (1)
- Australian Science Teachers' Journal (2)
- Biochemical Education (1)
- Bulletin of Science, Technology and Society (2)
- Canadian Journal of Environmental Education (2)
- Cognition & Instruction (2)
- Contemporary Educational Psychology (1)
- Ecologist (1)
- Education in Science (2)
- Educational Research (2)
- Electronic Journal of Science Education (9)
- Environmental Education Research (8)
- European Journal of Engineering Education (2)
- Evaluation & Program Planning (2)
- Gender and Education (1)
- Gifted Child Quarterly (1)
- Gigiena i Sanitariya (1)
- Green Teacher (1)
- Informal Learning Review (1)
- International Journal of Early Years Education (1)
- International Journal of Educational Reform (1)
- International Journal of Mathematical Education in Science and Technology (1)
- International Journal of Science Education (32)
- Issues in Science and Technology (1)
- Japanese Journal of Educational Psychology (1)
- Journal of Biological Education (1)
- Journal of Chemical Education (9)
- Journal of College Science Teaching (7)
- Journal of Community Health Nursing (1)
- Journal of Computers in Mathematics and Science Teaching (7)
- Journal of Educational Psychology (3)
- Journal of Elementary Science Education (4)
- Journal of Environmental Education (7)
- Journal of Experiential Education (1)
- Journal of Experimental Education (1)
- Journal of Higher Education (1)
- Journal of Interactive Learning Research (2)
- Journal of Learning Disabilities (1)
- Journal of the Learning Sciences (5)
- Journal of Research in Science Teaching (57)
- Journal of Science Education and Technology (8)
- Journal of Science Teacher Education (8)
- Journal of Women and Minorities in Science and Engineering (13)
- Learning & Instruction (4)
- Medical Teacher (2)
- Meridian (1)
- Mind, Culture, & Activity (1)
- Physics Education (1)
- Physiologist (1)
- Primary Science Review (5)
- PSSI Forum (Past Sixteen Science Issues) (2)
- Reports of the National Center for Science Education (1)
- Research in Higher Education (1)
- Research in Middle Level Education Quarterly (1)
- Research in Science Education (20)
- Research in Science and Technological Education (15)
- Roeper Review (1)
- School Science and Mathematics (4)
- School Science Review (10)
- Science (1)
- Science and Education (9)
- Science Education (25)
- Science Education International (7)
- Science Educator (2)
- Science Teacher (3)
- Sociology of Education (1)
- South African Journal of Higher Education (2)
- Studies in Educational Evaluation (1)
- Studies in Science Education (5)
- Teaching and Change (1)
- Teaching & Teacher Education (1)
Science Education Research Papers, Monographs, and Electronic Documents

Lynda C. Titterington & Youngsun Kwak
The Ohio State University

Listed here are 114 papers, monographs, and electronic documents in science education research. The papers and monographs were produced in 1998 and abstracted in the ERIC database by the end of July, 1999. The electronic documents are listed as they appeared on the Internet in September or October, 1999. Some URLs are given as search or index screens when actual document URLs are unwieldy. Each entry is coded (see Key to Codes, page ix) with one to three major codes (in bold type) and up to three minor codes, as well as the educational level (in parentheses). All entries are indexed by major codes in the Research Directory (see page 1).


This paper tests the central thesis of systemic reform and derives lessons about strengths and weaknesses of actual reform strategies that are used in policy and practice. The case studies collect similar kinds of data for all nine systemic reform efforts operating during 1992-1996, thus permitting a methodologically controlled “snapshot” of parallel reforms.

ref (K-12)


Provides answers to questions about small-group instruction concerning the differences between cooperative learning and other forms of small-group instruction; research and theory in cooperative learning in higher education; and sources for using cooperative learning in SMET disciplines. For each question, the authors identify resources that provide additional information, and then identify 99 additional resources that may be of value to SMET researchers and practitioners.

cpl, lth, cid, res (PS)


This Brief offers an initial look at one science Web site, The Why Files, to understand how the Web can be used to enhance science-related learning. The Brief offers a preliminary look at the expertise and finances required to develop and maintain a site...
like The Why Files, patterns of site usage, and user characteristics.

dat, lrg (ALL)


This report provides a synopsis of the issues and ideas that emerged during a 1997 conference in which the National Institute for Science Education (NISE) brought together faculty members of NISE and other individuals with specific expertise or experience pertaining to interdisciplinary collaboration and problem solving.

ref, int, pbs (ALL)


This digest provides an overview of the Head Start on Science (HSS) program, which is designed to encourage science literacy of preschool children in Head Start programs and to improve the capacity of Head Start teachers, assistants, and parents. The goals of HSS are to broaden participants’ science knowledge and conceptions, to enhance participants’ ability to use scientific inquiry, and to integrate HSS with the core curriculum.

lit, cur, inq, ref, tpd (EC)


This evaluation of mini-conferences conducted for Alabama teachers who completed training in the 1996 Summer Space Orientation for Professional Educators (SOPE) examines the effectiveness of follow-up sessions for teachers and provides baseline data regarding teachers’ knowledge of and attitudes toward teaching science.

esg, knt, tpd, att (K-12)


This report analyzes the contributions that the 10 Eisenhower Regional Mathematics and Science Education Consortia have made to the nation’s effort to reform mathematics and science education. The data presented in this report were collected largely in the spring of 1996 through surveys, interviews, site visits, and review of a variety of documents. Survey procedures, instruments, and program indicators are included in appendices.

tpd, ref, edd (K-12)


This publication presents an annotated listing of the research in science education that was reported in 1996. The listing includes doctoral dissertations, journal articles, conference papers, and other documents. This one-year snapshot provides an overview of the field for experienced researchers, doctoral students, and practitioners who use research findings.

res (ALL)


This document is an annotated listing of research in science education reported during 1997. The listing includes doctoral dissertations and master’s theses; journal articles and conference papers; electronic documents; and other items. The 1997 listing represents the first time an attempt has been made to incorporate electronic documents available on the World Wide Web and to include articles from
This paper characterizes the student body enrolled in GEOL 101 and also assesses the effectiveness of the associated class Web sites in terms of their ability to foster student learning, the capacity for complex problem solving, lifelong learning, and effective interpersonal interaction.


The author makes a case for considering science one of the humanities by describing the use of a Chautauqua Model in the state of Iowa to affect teacher attitude and behavior. Included in the model are a two-week experience with science, technology, and society teaching and learning (STS); a two and a half day short course; planning and using a 20-day STS module; identification of local resources; and a follow-up short course. A discussion of the positive effects of STS instruction is included.


This paper summarizes the research base for effective inservice and describes the features of Science PALS (Science: Parents, Activities and Literature), a four-year systemic reform effort. Data collected related to teachers' beliefs and perceptions of teaching were compared to their actual teaching as well as demographics, survey responses, and interviews. The results indicated that newer teachers were more likely to implement the Science PALS model. Teachers reported much higher levels of implementation than their teaching performance indicated.


This report provides detailed information about TIMSS and highlights the results related to mathematics and science literacy of final year school students in South Africa. It also discusses the results of students who took the TIMSS in their final year of schooling in detail and South African students' background.

Herbert, Bruce; Bednarz, Sarah; Boyd, Tom; Blake, Sally; Harder, Vicki; Sutter, Marilyn. (1998). Effective integration of the World Wide Web in earth science education. [SE061176]

This study examines the performance of biology majors who have taken one ecology course at the university 300-level as they used an ecosystems modeling tool (Environmental Decision Making, EDM) that allows users to pose their own problems
and seek satisfying solutions.

**pbs. cbi, rem. ene. bio. lrg (PS)**


This study focuses on preservice elementary education students' understanding of science and science learning as a meaning-making activity. Student reflection books were used to describe these beliefs during a 15-week, nontraditional, inquiry-based biology or physics course. A coding scheme was developed to describe and compare beliefs about science with beliefs about learning. Student beliefs of science making were different from their beliefs about science learning, possibly owing to their firmer beliefs about science teaching.

**nas, att, phe, att, knr (TE)**


This study examines middle school integrated mathematics and science education from theory and in practice. The theoretical component of this research addresses the ill-defined nature of integrated mathematics and science education, and presents the Math/Science Continuum as a conceptual framework to lend clarity and precision. The theoretical framework guided the design and implementation of a qualitative investigation of two case studies of middle school integrated mathematics and science education.

**int, lth, cur (MS)**

**Jarrett, Denise. (1998). Integrating technology into middle school mathematics: It's just good teaching.** Portland, OR: Northwest Regional Educational Laboratory. [SE062238]

The aim of this publication is to help teachers incorporate technology into learning activities. Chapters emphasize issues concerning mathematics and science education standards, teaching and learning with technology, ensuring equity, common instructional technology, succeeding with minimal resources, and changing classroom roles.

**ref, edt, ped, eqt, cur, skt (MS)**


This case study addresses attitudes and perceptions within an experiential context. Middle school student perceptions of science education were investigated by looking at attitudes toward instructional variables and perceptions of the nature of science, and then experiential education was considered as an approach to enhance attitudes and perceptions while improving students' understanding of science. The results distinguish between pre- and post-perceptions and attitudes, discuss themes of enhanced images of science and scientists, and propose a model to improve student perceptions of the nature of science.

**ats, nas, cns, ped (MS)**


This paper discusses the elaboration and application of "scientific culture" categories to analyze student discourse while solving problems in inquiry contexts. The data are drawn from case studies, in the context of a project about students' reasoning and argumentation in high school and university. Results from observation, videotaping, and audiotaping of students while working in groups solving problems about biology and physics showed that students use epistemic and procedural operations in a way related to scientific culture.

**cid, pbs. cpl, phe (HS, PS)**

Durban, South Africa: University of Natal Education Policy Unit. [SE061579]

This paper presents an analysis of the educational resources needed for transformation in schools. The paper presents both the context of science education and the teaching practices of science teachers as potential resources that can be marshaled to facilitate the transformation of science education in schools. The results suggest that huge potential for school change exists in teachers' knowledge, time available, human and textual resources, and various teaching practices that feature a transformative engagement.

at, kn, ref, cur, ped (SE)


This is one of two reports about the linking of NAEP results to TIMSS results for grade 8 mathematics and science. It describes the types of linking approaches considered, the method used to develop the linking functions, the sources of variability that affect the variance of the linking functions, and the validation and results obtained for grade 8 mathematics and science.

ach, asm, res (MS)


This issue brief discusses student flows into the United States higher education system, the stay rates of foreign doctoral recipients, and their short and long term employment in United States industry, universities, and government.

car, sts, tec, cul (PS)


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car, cul, sts (PS)


This study examines social aspects of the sciences and its role in the scarcity of women and of men of color in science. Interviews with science faculty examined gender and racial/ethnic issues in the professional domain for clues as to how the culture of science might influence demographic participation in science programs. Although scientists believe their training in the scientific method removes subjectivity from their treatment of people, the interviews indicate that people in the sciences are not treated equitably.

car, eqt, bkg, phe, gen, eth (PS)


The Pocket Panorama presents the findings of a study to examine the landscape of Ohio's Statewide Systemic Initiative (Discovery) to reform science and mathematics education. The funding includes identifying barriers (community and school resources, teaching practices, student attitudes) that may result in achievement differences among groups of students, as well as state funding to improve the college education of all teachers of science and mathematics.

eqt, ref, ach, tpd (TE, K-12)


This NISE Brief makes a case for reform that addresses multiple parts of an educational system, and increases the access, retention, and achievement of students from all subgroups in science and
mathematics education programs. It is recommended that program evaluators develop guideposts that include an equity metric as a way to measure progress toward equity. A chart of research validated indicators of equity and an initial equity plan for a central city school corporation are presented.


This paper analyzes educational equity in science and mathematics and proposes a practical way to assess equity in systemic reform. Based on an analysis of NELS:88, High School and Beyond, and TIMSS, indicators of equity are proposed. The efficacy of those indicators is analyzed by a review of the pertinent literature, and an equity metric is developed.


This document, intended as a companion to the Science Report Card and the Science State Report, presents results of the NAEP 1996 state assessment for grade 8 along with national and regional results from the NAEP 1996 National Assessment. Chapter 1 presents the results for the nation, the four regions, and the participating jurisdictions in the context of the overall average science scale scores and scale scores for the fields of science and the type of school. Chapter 2 presents scores for selected population subgroups. Chapters 3 through 7 relates the results to student, teacher, and school characteristics.


This paper reviews studies of inservice programs that aim to enhance mathematics and science teaching. It focuses exclusively on studies that examine effects of programs on student learning. The review suggests that the differences among programs that mattered most were differences in the content that was actually provided to teachers, not difference in program forms or structures.


This report presents part of a five-year study on the incorporation of industrial chemistry in the Israeli high school curriculum. The goals of the study were to gain information on teachers’ formal education and their attitudes about teaching this subject, as well as the contribution of inservice training to their needs. Findings from questionnaires and interviews suggested that inservice training of chemistry teachers hardly touches on industrial chemistry and few teachers experienced industrial chemistry prior to inservice training.


This goals of this study include determining the views of preservice teachers about the nature of science, documenting their use of concept mapping and electronic journaling in exploring concepts
related to the nature of science, and examining the evidence they use to support their arguments in the electronic journaling. The results suggest that students rely on figuring out a point for themselves rather than turning to research, theory, or authority. Students generally provide low levels of support for their ideas while carrying on their electronic journaling discussions.


This paper surveys the techniques and ideas of a large number of researchers who are seeking solutions to problems related to the nature of physics students' knowledge, the identification of alternative conceptions, and methods to overcome misconceptions. Background for a discussion of effective teaching methodology is provided by examining the nature of knowledge within the classroom and the shortcomings of educational models. The authors propose three techniques for overcoming alternative conceptions.


This qualitative study explored philosophies, life experiences, educational preparation, classroom techniques, and limitations that affect teaching efficacy for six middle school science teachers with one to four years of experience. The data identified personal characteristics and experiences typical of effective novices, barriers that discourage teachers from remaining in the profession, techniques that contribute to a successful learning environment, and suggestions to help new teachers cope with the stress associated with the induction years.


This report reviews the development of a structured interview protocol to identify the nature and scope of children's science-related activities outside of school. The protocol, Community and Home Activities Related to Technology and Science (CHARTS), comprises a version for preschool (CHARTS/PS) and school age (CHARTS/SA) children. The PS version was revised to include questions about a wider range of activities. This report includes a discussion of the original protocol and its modifications as well as suggestions for modifying the protocol for other research purposes.

Kuh, William; Simmons, Jerry; Sorge, Carmen; Whittle, Christopher. (1998). *Group study on adult learning at the Explora Science Center, Albuquerque, New Mexico, USA*. [SE061195]

This research presents a qualitative and quantitative study on adult learning in an informal, hands-on setting with the goals of observing and determining the learner characteristics that are crucial to the learning experience, and determining the multicultural use factors in a culturally diverse community. Included are statistical information about who visits which exhibits for what period of time. The findings indicate that there age, gender, and ethnicity affects adult visitors' interactions with the exhibits.


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This study describes how students in an introductory course in hydrology used a Vee map to guide their laboratory investigation. At the end of the investigation, students complete a survey evaluating their perceptions about using the Vee map approach over the traditional, direct laboratory approach. The results of this study suggest that Vee maps have the potential to stimulate more thinking and learning than is commonly experienced in the traditional laboratory format.

**lab, ped, lsy, esg, ats (PS)**


This paper reviews documents on science content standards (NSES and Project 2061), performance standards (New Standards), and large-scale assessment frameworks (1996 NAEP and TIMSS). The results indicate that there is an overall agreement on the conceptions of science achievement. Although equity is emphasized, science achievement is defined in the tradition of Western science. Alternative perspectives from multiculturalism, feminism, critical theory, and postmodernism are considered to develop a broader conception to include students from diverse backgrounds.

**ref, eqt, asm, mce, phe (K-12)**


This paper interrogates what masculine construction and practice of science means to boys (and by extension, to girls as well) in the science classroom.

Using data gathered during primary school science lessons, it examines how school science recapitulates a hegemonic version of masculinity that is middle class. The author discusses implications for the discipline of science and for the science classrooms, in terms of the structure of the curriculum and the pedagogies used to convey that curriculum.

**gen, nas, phe, cur, eqt (EL)**


This study used a quasi-experimental design to identify the benefit of teaching chemistry through history to students in the last two years of a teacher preparation program. One group learned how to develop and teach chemistry through the history of science and the control group used standard practices. Analysis of covariance revealed that the experimental group outperformed the control regarding their understanding of the nature of science and scientific observations, and the function of theories and creativity.

**nas, his, knt, che, tpd (TE)**


This study reports the improvement of a teacher researcher's practice by adopting a constructivist approach for teaching. The nervous system, human circulatory system, evolution, and vertebrate classification were selected as topics of study to illustrate a model of biology teaching. Data from student responses to open-ended discussion questions, attitude surveys, interviews, and document analysis indicated that students show positive attitudes towards cooperative learning and increased understanding of the nature of science.

**cns, ats, cpl, nas, cur, bio (SE)**


This report addresses the following indicators of progress and achievement: student impact, teacher impact, policy changes, resource changes, management change, data utilization, learning infrastructure change, student performance, and partnerships. The review was designed to gain a full understanding of the appropriately documented, effectively measured, significant, and reliable indicators by which progress is assessed as per the Statewide Systemic Initiative Program objectives.

ref, res, tpd. asm. cur (K-12, TE)


This study explores how an Inquiry Based Demonstration Classroom (IBD) professional development program affects the extended inquiry instruction of secondary science teachers, and how teachers view their extended inquiry practice while involved in the IBD professional development program. Participants were observed while enacting extended inquiry lessons, and data was recorded on the Extended Inquiry Observational Rubric and analyzed for changes in eight categories using a dependent t test.

tpd, inq, ped (SE)


This study investigated how Portuguese teachers judge their own knowledge about science-related social issues. The survey involved 464 teachers from primary school to university level, teaching science and nonscience courses. The issues, selected on the basis of their social relevance, included radioactivity, consumer education, environmental problems, and food. The results indicated that over fifty percent of the teachers thought that they knew very little or just a little about the majority of the themes.

The authors argue that this situation could put the scientific literacy of their students at risk.

sts, knt, lft, att (K-12, TE)


This study explores the learning styles of monozygotic twins with the aim of discovering patterns and emergent themes of benefit to educators, parents, and twins. Fifty pairs of twins participated in the study, and the data was collected from in-depth interviewing, grounded surveys, document analysis, and the use of a learning styles instrument. The results indicate that twins exhibit great similarity in motivation for studying science and unique communication patterns.

isv, car, chs (ALL)


This study explored the knowledge of the general population regarding cloning and sought to determine where people gather information on cloning. Findings indicated that participants realize their knowledge about cloning is limited and inadequate for making informed decisions; few were able to relate cloning to all its applications or uses; most were unsure if they used products developed or made from cloning technology. The most frequently reported source of information was television news and magazines; however, respondents cited libraries and the Internet as resources for the most factual information.

lit, sts, kns, bio, ndf (AD)

Teaching (San Diego, CA, April 19-22, 1998). [SE061828]

In this study, electronic networking was introduced as a means to provide a social context in which preservice elementary teachers could learn collaboratively, share and reflect upon science teaching experiences and practices, conduct teleresearch, and meet the demands of student teaching through peer support. Networking included electronic mail, newsgroups, listserv, world wide web access, and electronic mentoring. Findings from quasi-experimental pretest posttest control group design suggest that electronic networking is beneficial.

att, ntw, tpd, kn (EL, TE)


This paper reports a collaborative research project conducted by two first grade teachers that focuses on the use of hands-on science activities in an integrated science curriculum. Data from student interviews, a student survey, and student science journals compare oral language ability versus written language ability, show the effect of an inadequate scientific vocabulary on science learning, and the various paths taken to get a correct answer. The relationship between a teacher and her mentor is also discussed.

hos, int, lrg, ped, cur, tpd (EL, TE)


This paper reports a longitudinal study to measure teacher candidates' attitudes and beliefs about the nature of and the teaching of mathematics and science using the Attitudes and Beliefs about the Nature of and the Teaching of Mathematics and Science instrument. The authors report how candidates' attitudes and beliefs evolved over a two-year period. The results indicate that candidates' attitudes and beliefs moved in the desired direction on all five subscales of the instrument.

att, bfs, nas (TE)


This paper reflects on how the research program conducted in the Maryland Collaborative for Teacher Preparation (MCTP) informs the evaluation of the project. The paper presents an overview of the MCTP and the MCTP research program, a literature review on evaluation and research, and the use of MCTP research to inform evaluation.

asm, res, tpd (TE)


This study describes and interprets five teachers' classroom practices of infusing STS into the science curriculum after they completed an inservice educational experience. The results indicate that the teachers perceived themselves as outsiders to the perceived school culture and decreased their teaching of controversial issues. The findings suggest that teacher education experiences must include opportunities for practitioners to consider how their beliefs about the local school cultures may affect teaching practices.

sts, att, ped, cur, tpd, kn (TE)


This study correlates the learning styles of African American children as described in the literature are related to the temperaments defined by the
Myers Briggs Type Indicator (MBTI). Analysis of the
data show learning style differences among African American youth and a population of white male students, and that the learning styles of African Americans have more heterogeneity than previously reported.

Ibsy, eth, chs, lrg (K-12)


This document presents the written records of the Third Annual National Institute for Science Education (NISE) Forum on indicators of success in postsecondary science, mathematics, engineering and technology (SMET) education. These Proceedings comprise the opening keynote, a digest of the three panel discussions, the remarks of panel discussants, a synthesis of participants' observations written after each panel discussion (think pieces), the closing reflections, an analysis of the participants' theories of change, and the presenters' papers.

ref, res (SE)


This study attempts to identify the critical attitudes and concerns of female undergraduate students considering graduate study in the sciences. It considers the factors the women feel contribute to their interest and success in the sciences to that point and the barriers they perceive they needed to overcome in continuing their studies. The findings may provide insights to science educators and career counselors for developing and implementing interventions to increase the participation of women in science careers.

gem, car, ats, eqt (PS)


This qualitative study examines to what extent high school teachers' beliefs in contemporary science education goals are embedded in routine classroom practice. Data gathered from a learning community-based high school sensitive to reform issues included video, observer field-notes, interviews, reflexive journals, and responses to a contemporary goals survey. Examples from transcripts of connections between teacher beliefs and classroom practices and implications for further research are included.

bfs, cld, ped, att (HS)


This report, part of TIMSS, presents the results of a 24 nation study of math and science achievement for students in their final year of secondary school. The data is organized into broad categories related to mathematics and science literacy, contexts for achievement in mathematics and science, and advanced mathematics and physics achievement. The appendices provide information related to the development of the TIMSS tests, sample sizes and population rates, compliance with sampling guidelines, and the test-curriculum matching analysis.

ach, cul, lit, sks, pbs (HS)


This study presents a two-year experiment in web-based genetics education. A university team worked with a high school biology class and a middle school
science class to develop a World Wide Web site to teach molecular genetics in fun and engaging ways. Pairs of high school and middle school students worked on genetics research projects by gathering survey data in their schools and data from the Web. Interactive Web pages and a webboard guided students during their research. Data sources included genetics and technology literacy surveys, webboard postings, and interviews with teachers and students. The study identified factors related to Web design and implementation and used them to develop a model of student-centered web-based science instruction.


This study examined the influence of the Detroit Urban Systemic Initiative on the use of constructivist-oriented, standards-based instructional practice as well as the perceived adequacy of the curriculum for standards-based instruction. In results from teacher and student questionnaires and school case studies, teachers reported that they frequently use inquiry learning, ongoing assessment, and learning communities, and that they are involved in curriculum planning and decision making. Student surveys agreed with teacher reports. Findings indicate that standards-based teaching practice increased from 1996-97.


This study, part of an effort to implement a technology-enhanced, integrated curriculum in rural schools, examined grade 5 students’ interactions with and attitudes toward using the Internet as a learning tool. Student pairs completed worksheets pertaining to each website they experienced on a guided tour. Observational analysis indicated that student engagement increased as they progressed through the exercise. Results from an attitude survey indicated that the students were not intimidated by the Internet and were empowered to use it further.


This report about teachers’ academic preparation and professional development, the amount of emphasis science instruction receives in schools, student course taking, and the availability of school resources that support science learning is intended primarily for policy makers, school administrators, and educators concerned with state or school level policies. The data is drawn from the 1996 National Assessment of Educational Progress (NAEP).


This study examined the effect of a conceptual change teaching strategy over the traditional method on high school students’ attitudes towards learning biology. The study employed a two-group experimental control design with the experimental group taught using a conceptual change teaching strategy. Analysis of a 21-item instrument showed a significant difference in the attitude of students in the two classes after the treatment. The U-test value of the groups was also significant.

The Division of Science Resources Studies of the National Science Foundation reports statistical data related to total science and engineering graduate enrollment. Included in the overview of the report are data related to: graduate enrollment in science and engineering by enrollment status, 1979-97; graduate students in science and engineering by sex, citizenship, and race/ethnicity, 1990-97; and graduate students in science and engineering by field, 1990-97.

This paper argues in support of training little scientists based on the requirements of participation in a media-laden, democratic society fraught with scientific claims and counterclaims. The leads to a framework for evaluating the effectiveness of various approaches to science education including how they play out in practice. The promise of this framework is also demonstrated by examining some results of case study and survey research in project based science classes at the high school level.


This paper examines the establishment of a collaborative science education learning community over a five-year period. By assuming a pluralistic theoretical perspective which is influenced by postcritical theory, postmodernism, poststructuralism, and feminism, the paper focuses on the challenges experienced in developing a learning community among student teachers, classroom teachers, and university faculty.


This master’s thesis examines the effects of using mnemonics to teach the solar system to a heterogeneous group of regular and special education students in grade 9. The control group received facts about the solar system through lecture and transparencies, and students recorded the information into an outline format. The experimental group received the same facts in lecture and recorded the notes into a mnemonic format. The findings indicate that the students enjoyed the mnemonic and would use it in the future.


This study developed and tested of two versions of a teacher efficacy scale: a teacher efficacy scale and a science teaching efficacy belief instrument. The instruments were given to students in an elementary science methods class. The results indicated a negative correlation between the analogous scales of the two instruments. Preservice teachers with high personal efficacy tended to have lower science teaching efficacy, and those with high science teaching efficacy tended to have lower general teaching efficacy.


This paper sets reports the development of the Inquiry Matrix instrument and its use to describe and analyze instruction in science classrooms. The papers present Modified-Revised Science Teacher's Behavior Inventory (M-RSTBI) data from earlier studies and re-examine videocassettes from those studies using the Inquiry Matrix. Results indicate the Inquiry Matrix effectively defined and described inquiry in terms both modeled science instruction and classroom instruction.

This research, to devise an intervention to enhance three dimensional (3-D) anatomical understanding in first year veterinary students, compared the study of cross section anatomical diagrams to dissection of the canine head to see which students developed a better understanding of the 3-D locations and relationships of structures. The study also compared the two methods on the extent to which spatial ability transferred to other areas of the body, and compared the spatial abilities between genders. Analysis of covariance revealed no statistically significant gender or group differences.

sks, gen, bio, cur (PS)


This study examines the nature of socio-cognitive influences on general chemistry students' learning in terms of critical thinking skills and academic grades. Learning and success, considered functions of enculturation and empowerment, are measured through both quantitative and qualitative means. A discussion of epistemological racism, institutionalized racism, and the context of gender is also included.

bkg, ach, che, eqt. gen. eth (PS)


This study investigates preservice teachers' development of an understanding of scientific inquiry as a result of their participation in a five-week elementary science methods class. Data collected from the final examination suggest that students developed an understanding of scientific inquiry. Students' written responses to a particular work of art demonstrated that a short-term exposure to elementary methods is capable of producing behavioral changes in preservice teachers at the linguistic level.

knt, inq, nas, tpd (TE, EL)


This guide demonstrates how to apply the National Science Education Standards to the real world of the middle school classroom. The sections outline standards for science teaching, professional development, assessment, content as well as on the program and system level. Following the unifying concepts and processes outlined in the Standards, the book provides classroom vignettes that illustrate how teachers are implementing the standards in their classroom.

cur, lit, ref, tpd, ped, asm (MS)


The study presents the results of an open-ended questionnaire on positive and negative science experiences and the preliminary findings for development of a survey instrument based on those results. The objective of the study was to determine if there are detectable differences in prior science experiences science majors and nonmajors. The results indicate that teachers, the learning environment, and perceived success in learning contribute to the positive or negative nature of prior science experiences.

bkg, car, ats, chs (PS)


This paper examines changes in research and development emphasis in the academic sector by analyzing shifts in the science and engineering...
field shares during the 1970s, 1980s and 1990s. It discusses the shifting distribution of overall funds among science and engineering fields and their impact on individual fields. The data is examined to determine whether major differences exist in the shifts in field shares for federal and nonfederal funds for academic research and development.

res, car, tec (PS)


This paper reviews four decades of research on race and education in Great Britain and discusses the deficit theories of under achievement that structure most of the studies. The study focuses on black youth of Caribbean origin and includes a summary of interviews with parents, students, and teachers. It also discusses constructive frameworks from gender and political dimension research, parental involvement, role models and cultural identity, career guidance, and multicultural education techniques.

ach, eth, eqt, mce, bfs, phe (K-12)


This document presents proceedings of the Second Annual Spring Conference, a newly formed organization for graduate students in mathematics, science, and technology education. A copy of the conference program and presentation abstracts are included.

edt, res, cpl, pbs, ref, cid (ALL)


These proceedings comprise 11 reviewed and edited papers from the 23rd annual meeting of the Western Australian Science Education Association. Topics include teacher behaviors, approaches for teaching large science classes, assessment, and Web-based instruction, as well as learning theory and teaching methods.

res, tpd, lth, cbi, cid, asm (ALL)


This paper focuses on students with learning disabilities who may behave inappropriately due to frustration about their academic deficits. This perception may be the result of text-driven, teacher-centered instruction conveyed through visual and auditory channels. The paper discusses meeting the needs of students with disabilities through an integrated curriculum, and presents a sample thematic unit on butterflies and insects developed for three ability levels that integrates scientific, language arts, and research skills.

chs, int, ats, ref, ped (K-12)


This newsletter promotes the reform of assessment systems as an essential component of systemic reform. Topics include sharing conceptual understanding among all stakeholders in the educational system, evaluating the impact of systemic reforms in terms of student attainment of relevant goals, and ideas on how assessment can play a major role in guiding systemic reform. The ideas are applicable to science education.

asm, cur, ref (K-12)


The paper describes three styles of modeling in science: analytic, exemplified by eighteenth century
physics: systemic, exemplified by biology; and macro-systemic, exemplified by studies of ecologies undergoing change. This monograph considers the approaches taken to evaluation and inquiry in some of these disciplines, notably epidemiology and ecology, and the central roles that evaluation plays in planning and monitoring change.


This monograph presents a nontraditional teacher preparation program for mid-career and second-career teachers. Through analysis of this single program and its outcomes, the authors illustrate how the traditional familiar route to teacher certification can be expanded and enhanced by facilitating the entry of scientists and mathematicians into teaching as a second career.


In this book about curriculum and meaning, the authors argue that the socialization of students is not only a matter of their deportment, attitudes, and conduct, but is also very significantly associated with the meanings provided by their educational experiences. The chapters, organized under the headings Back to the Drawing Board, Into the Classroom, and Behind the Scenes, include such authors as: D.A. Roberts, T. Englund, B. Kilbourn, R. Saljo, L. Ostman, J. Willinsky, G. S. Aikenhead, H. Munby, A. Geddes, G. Orpwood, R. W. Bybee, J. Solomon, and P.J. Fensham.


The 40 papers from this conference explore topics related to science teacher education such as gender issues, instructional materials, integrated curricula, constructivist assessment practices, mentoring, conceptions held about astronomy, science standards, literacy through the learning cycle, skills for secondary science teachers and students' perceptions of science teaching.


An approach to teaching problem solving based on using the computer software, Mathematica, is applied to the study of electrostatics and is compared with the normal approach to the module. The experimental course addresses student misconceptions, and the students found the visualization tools to be more instructive than the problem solving tools. Included are a discussion of how the course can be improved, and how the course can be a valuable supplement to the usual teaching approach.


This paper focuses on the evaluation of an 11-week curriculum created to foster grade 7 students' understanding of scientific modeling. Students created non-Newtonian computer microworlds to embody their conceptual models, evaluated their models with criteria, and reflected on the nature of models. The analysis suggests that students gain a significantly better understanding of the process of creating and evaluating models. These results indicate that while modeling knowledge is difficult to obtain even from extended practice, progress can be furthered by refining model-oriented curricula and assessments.


This paper describes part of a cross-national study of learning environments in Taiwan and Australia pertaining to the development and validation of an instrument, The Teacher Student Interaction (TSI), to assess student perceptions of their teacher's behaviors. Data from student surveys was quantitatively analyzed, the questionnaire validated and qualitative descriptions of teacher behavior were obtained. Interviews and classroom observations were used to further validate the questionnaire and understand the teacher interactions according to the perceptions of students.

cid, cul, ats, cht (SE)


This paper describes the implementation of a curriculum framework and Internet-based software toolset called the Knowledge Integration Environment (KIE) in two urban schools, and uses the framework of Scaffolded Knowledge Integration (SKI) to assess the interplay between teaching and using new learning tools. Results indicate that improvements in cognitive engagement and learning were achieved by students who had been labeled "failures" in traditional classrooms, and that advanced students integrated their knowledge in new ways. The paper offers suggestions for evaluating the contextual issues that shape the implementation of new learning environments, and presents SKI as a framework to support teacher professional development as they adopt new tools and techniques.

cbi, cur, ach, sks, kns, tpd (HS, TE)


This study identifies the most common biological concepts presented in elementary science textbooks in Taiwan. Results of the study indicate that the commonly addressed attributes are: habitat, movement, growth, energy source, and structure. Concepts are organized from high level to low level and links among the concepts within a unit or across units are not adequately made. The application of concepts is neglected and inquiry-based experiments are lacking.

mat, bio, inq (EL)


This study is part of a local systemic reform effort to implement interactive-constructivist teaching and learning that includes hands-on activities to challenge students' ideas and to promote deep processing and conceptual change. The study verified the use of students' perceptions and attitudes and supervisor's ratings as measures of teachers' implementation of interactive-constructivist teaching in the classroom. Students' perceptions and attitudes and expert ratings of constructivist science teaching had marginal external validity.

cns, asm, ats, hos, csg, ref (EL)


This paper describes an elementary science curriculum, called the Science: Parents, Activities, and Literature (Science PALS) Project. The project emphasized interactive-constructivist teaching and learning, with hands-on activities to challenge students' ideas and to promote deep processing and conceptual change. The study explored students' perceptions of and attitudes in classrooms of teachers who were or were not participating in the project. Perceptions and attitudes were higher in classrooms of teachers with 2 or more years of Science PALS experience than in classrooms of teachers with less experience.

ats, ref, cns, csg, ped, hos (EL)
Simmons, M. Ruth. (1998). A study of high school students' attitudes toward the environment and completion of an environmental science course. [SE061701]

This study examined the effects of an elective environmental education course on student attitudes. A questionnaire was used to survey four components of student attitudes: beliefs and values; behavior intentions; behavior; and affective responses. Students in both groups had positive attitudes toward the environment. The environmental science group had more positive attitudes toward the environment than the school at large, overall and within each attitude component. Attitudes toward the environment did not change significantly over the school year, and there was no evidence to indicate that completion of the course was related to attitude change.

ats, ene (SE)


This article explores aspects of multicultural science and pedagogy and describes a branch of indigenous science known to biologists and ecologists as traditional ecological knowledge (TEK). Indigenous science relates to both the science knowledge of long-resident, usually oral culture peoples, as well as the science knowledge of all peoples who are affected by the world view and relativist interests of their home communities. A discussion of TEK literature provides numerous examples of effective indigenous science.

mce, bfs, phe, kns. bio, cur (ALL)


This study examines the improvement in science content knowledge, process skills, and attitudes of grade seven students after the implementation of a reform effort. Relationships among gender, school location, and performance are also investigated. Data from a science process skills test, a standardized multiple choice content test, and an adapted attitudes to science test indicate that the students display positive attitudes to science on the pre and posttests; there are no gender differences in performance on the three tests; and there are positive correlations among school location and test performance.

ref, ats, sks, gen, kns (MS)


This study examines Jamaican high school students' comprehension of four integrated science textbooks and the relationships among their grade level, gender, school location and type. Results from Cloze comprehension and vocabulary tests indicate that most of the subjects could not comprehend the texts. Urban and traditional students significantly outscored their rural and nontraditional counterparts on all the tests, and girls significantly outscored boys on two of the comprehension tests.

int, mat, lrg (SE)


This report describes a methods course for elementary education majors that is based on the structure of the Florida Sunshine State Standards for science. The content of the course includes pedagogical knowledge beyond the type of information obtained in science content courses taken by students during the first two years of undergraduate study. A student assessment of the course and instructor comments are also provided.

ref, tpd, kns, ped (EL, TE)

This document presents guidelines for strengthening the preparation of elementary science teachers. Focusing on collaboration between teachers of all grade levels, the guidelines prescribe a learning environment that includes collaboratively designed and implemented program support, hands-on problem solving, and student-centered instruction. Other suggestions include placing scientific inquiry at the core of all levels of science teaching and learning and regarding professional growth in science teaching as a continuous and collaborative process.


This report from TIMSS compares the general mathematics and science knowledge of U.S. students in grade 12 with that of 35 other countries. The document presents background information about TIMSS, and describes how all U.S. students performed in mathematics and science, as well as examining the achievement of advanced students. It also analyzes the context of learning in included countries. More detailed statistical data are presented in the appendices.


This study investigated the effects of the MORE (Model, Observe, Reflect, Explain) curriculum on undergraduate chemistry students' inquiry skills. MORE emphasizes thinking through the inquiry process, rather than the mechanics of laboratory procedures and algorithmic calculations. The study examined classroom interactions in traditional laboratories and MORE lab sections taught within the same lecture course. Analysis of videotapes from each lab environment indicated that the MORE approach improved student ability to design experiments and make connections between actions and models.


This study examines the effects of an analogy activity designed to overcome eighth grade students' misconceptions about the microscopic views of phase change. The students were assigned to either a control group (traditional teaching), or an experimental group that participated in an activity in which students, acting as particles, worked together to model phase changes. Results from an immediate posttest indicated that the experimental group did not perform significantly better than the control. The delayed test indicated that the analogy activity increased students' understanding.


This paper compares the responses of Australian and Taiwanese tenth grade students to the Teacher Knowledge Questionnaire. The study compares the mean scores of each item in the two countries and uses qualitative research methods (classroom observations and interviews) to probe students' reasons for their responses to the questionnaire. The findings indicate that, compared to Australian teachers, Taiwanese teachers use more verbal illustrations to teach science concepts, concentrate on scientific theories and principles, and reinforce students' memorization and calculating ability. Australian teachers are more likely to help students extend their science learning to daily life.

This paper examines privileging and other mechanisms at play over a period of six classroom days. How the claims and ideas of a number of students fare in the larger classroom community discourse is described and supported by brief case studies of student pairs and groups, including transcripts of interactions. The author also reviews the characteristics of student-centered classrooms.


This study investigates teachers' perceptions of the instructional role of the history of science, and their actual practices of teaching science from an historical point of view. The paper describes the design of an instrument, the History of Science Instructional Survey, and presents the findings and implications from using it to survey teachers.


This study explores the trends for conducting textbook content analysis method in the science educational research, and how these trends address daily instructional needs. The paper reviews the literature on the role of instructional materials, especially textbooks in science education research; past content analysis methods for science textbooks; and research of instructional needs and recommendations. It also proposes a content analysis method for teacher education that is based upon a preliminary survey of teacher needs.


This paper examines pedagogical content knowledge through a case study of a fifth-grade teacher as she investigates aquatic ecology over a period of several months, in the context of a four-year project in which teachers examined science, science learning, and teaching through their own and their students' experience as learners. The results address how the teacher came to see her own learning and that of her students as she worked to understand aspects of the ecology of a local pond; and how her experience figured in her identity as a learner and her practice as a teacher.


This Occasional Paper is a summary of the responses to five questions distributed to NISE Fellows for the purpose of gathering information on their experiences. The questions asked respondents how they learned about the NISE Fellow opportunity, their reasons for pursuing a NISE Fellowship; and how the NISE experiences affected their professional growth as well as their assessment of the NISE experience and suggestions for improving the Fellowship.


This study seeks to discern the effects of the cultural problems identified by other researchers in a science educational setting. Field observations at the New Mexico Museum of Natural History and Science focused on: gender differences exhibited by visitors in interacting with the exhibits, age differences in patterns of interaction, and what sociological theory of education best fits with the observations. The
results have implications for how we teach science to girls.


This study explores the educational effects of television. The findings suggest that science and educational programming are not reaching vast numbers of the population, that people learn from television, and viewers do not relate well to scientists as they are portrayed in the media. Recommendations for increasing the effectiveness of television as a learning tool in science include: incorporating realistic science content into popular television programming, and involving the public in discussions about what science is important.


This report chronicled the experiences of an elementary education instructor and her students during their first distance learning course. Positive student responses included accessibility of courses previously unavailable; learning new technologies and learning from students at different locations; and being more involved in their own learning. Problems included technology problems and less teacher contact, but concerns about the amount of teacher-student contact declined as the semester progressed. Students who used e-mail to correspond with the instructor indicated that they felt they had more interaction and feedback than in traditional classes.


This paper reports the findings from the first two years of the Western Australian School Effectiveness Study, a longitudinal study undertaken in 21 urban and rural schools to identify the characteristics of effective rural high schools in science and mathematics achievement. The results suggest that most variability in student achievement is at the classroom and student level, with negligible amounts at the school level, and that effective schools are characterized by high morale and self-esteem for staff and students.


This data brief presents statistics related to employment of scientists and engineers in 1995.

Organized by broad occupation and degree received, the data is divided into four charts that provide information related to: number of employed scientists and engineers; percentage distribution; unemployment rates; and median annual salaries.


This study investigates the questioning strategies adopted by junior high school biology teachers during classroom instruction, and compares them with those of experienced teachers. From classroom observation, document analysis, and interviews of one beginning teacher and two experienced teachers, the findings suggest that the generative learning model can be a useful framework to help science teachers forming various types of questions and in improving a teacher’s questioning strategy.

This study explores the nature and meaning of epistemological and affective issues that shape elementary teachers' work such as ways of knowing, beliefs about the nature of science, and teachers' images of themselves as knowers. Through analyses of two teachers' narratives, classroom observations, and instructional materials, this research reveals how emotions and values are significant dimensions of teaching science and can explicitly or implicitly be part of their personal and professional development.


This paper reports on the rules of practice, practical principles, and images of teaching that student science teachers (n=32) constructed from listening to and discussing the stories inservice science supervisors told about a novice science teacher. The results delineate the rules of practice gleaned from each story and practical knowledge themes evident in the students' discussions. Excerpts from the transcripts are provided.

att, kn, tpd, cur (TE)
Science Education Dissertations and Theses
Suzanne Shaw Drummer, Chris A. Ingersol, & Joyce C. Miller
The Ohio State University

Listed here are 234 dissertations and master's theses in science education that were completed in 1998 and abstracted in Dissertation Abstracts International during 1998 through October 1999. Each entry is coded (see Key to Codes) with one to three major codes (in bold type), a maximum of three minor codes, and an indication of educational level (in parentheses). All entries are indexed by major codes in the Research Directory (see page 1). An index of dissertations and theses by institution is included at the end of this section (see page 123).


This study compares the knowledge and reasoning about global warming of 10 twelfth grade students and 6 specialists, including scientists and policy analysts. The study uses global warming as a context for addressing the broad objective of formulating goals for scientific literacy.

kns, car. lli, ene, sks (HS)


This study examines the effect of two modes of assessment on students' (n=104) performance. Fifth grade LEP students were asked to answer the same open-ended question by writing paragraphs or making drawings. Results show that students in the drawing mode performed better in in-depth concept development than those in the writing mode.

asm, sks, chs, kns (EL)


This study reports on a survey of biology teachers that considered their attitudes toward evolution. Although teachers consider evolution important, instructional time allocated to it is insufficient. Teachers' knowledge base was the most significant factor in the degree of classroom emphasis on evolution. Many teachers avoid discussion of human evolution and hold extreme views on creationism as a component of the curriculum.

evo, knn, att, cht. bio, tpd (SE. TE)


Science class periods were randomly assigned to three conditions. Results indicate that students in the simulation before dissection condition performed significantly better than the dissection before simulation and dissection-only conditions on both the actual dissection and on knowledge of the anatomy and morphology.

cbi, lrg, lab, ped. gen. ats (MS)


The subjects of this study were four, fifth-grade public school math and science teachers and
approximately 300 fifth-grade students. Student misbehavior during 50-minute science lessons was examined over one academic year. The findings indicate that the majority of misbehavior occurred in the lecture classrooms.

cpl, ped, ats, cid (EL)


The instrument used in the study was the Classroom Environment Scale (CES), Real Form. There were 40 secondary science teachers and 1200 students sampled in the study which sought to determine the relationship between teachers' educational background and students' perception of the classroom environment.

knt, cht, ats, bkg, ktp, tpd (TE, HS)


This research focuses on four new high school chemistry teachers who graduated from two different teacher preparation programs at major research universities. The key findings involve major differences between education and science content courses experienced by the teachers and the lack of student-centered teaching.

tpd, skt, cht, bkg, knt, che (HS)


This study (n=68) investigates whether learning thinking strategies presented within the course context resulted in increased academic performance and critical thinking skills. The experimental group used a student-generated questioning technique along with lecture presentations. All students were pre- and posttested using the LASSI and the CCTST. No significant differences were demonstrated.

ped, chs, pbs, sks, kns (PS)


The quasi-experimental study used a pretest-posttest control group design involving ten language arts teachers and their students (N = 500). Student perceptions of scientists were measured before and after the program by the Draw-A-Scientist Test and attitudes were measured with the Women in Science Scale. The study showed that participation in the WAST program and a student's gender and ethnicity made a significant difference in student's perceptions.

ats, gen, eth, car, cur (MS)


A survey was completed by 368 high school students in rural settings. Gender, race, tracking, and socioeconomic differences in career selection variables and future aspirations of pursuing a science-related career were explored. Results indicate differences based on race and gender. Science career interest was predictive of future career selection for this sample.

car, chs, bkg, gen, eth (HS)


This study sought to understand the practice of CAI and its effectiveness, especially in helping the under-prepared student. Results show that the faculty was primarily self-motivated and self-
taught in their use of CAI, was confident that expectations of helping students have been met and that CAI is becoming the most valuable of learning tools.

**cbi, bio, att, lab, ped (PS)**


This research investigated how to design and introduce an educational innovation into a classroom setting to support learning. The research yields cognitive design principles for instruction involving scientific argumentation and debate. Results from the research were synthesized in design principles geared towards helping future designers.

**cur, nas, ced, ped, lrg (MS)**


Tools of discourse analysis were used to examine teachers’ conversations in a seminar as they learned about the concept of buoyancy, and as they came to reanalyze students’ learning of the same topic. This analysis suggests that extended conversations grounded in science texts, classroom videotape and transcript data can deepen teachers’ conceptual and pedagogical understanding.

**cid, tpd, kns, phy, lth (TE)**


Two models of student publishing on the World Wide Web were investigated over the course of two project-based science curriculums. Findings for the two models were different and include a consideration of the ability of the web to motivate student learning and thinking and the ability of students to evaluate web sites for content.

**cbe, int, lrg, pbs, sks, ats (HS)**

This qualitative study examined the environmental concepts of 75 rural Hondurans. Conceptual analysis was used to construct a tentative interpretation of the rural Honduran worldview. Results recommend an educational approach that fosters the integration of compatible environmental concepts into the rural Honduran worldview through the application of design strategies for a prospective environmental education process.


Student performance on products was compared with several characteristics of the students and of the groups within which they worked. Success was dependent upon developing mastery goal orientations, holistic views, and positive group interaction skills. These results suggest that alternative assessments may be used to evaluate and support the goals of science education reform efforts.


Forty-three students with ChemCom as their high school chemistry background and forty-three students with a traditional chemistry background were sampled. The ChemCom and non-ChemCom students with similar high school backgrounds were comparable in achievement in a university chemistry course and in attitude toward technological and societal issues.


Quantitative data was collected from five Science 9 teachers, 43 students, and 21 parents who volunteered for the study. Results show that while most participants were satisfied with the reporting of student progress, individual teachers consider different kinds of assessment information when they assign letter grades, are not always clear and consistent about what they intend letter grades to mean, and students’ and parents’ beliefs about the grading components and meanings of letter grades vary widely.


Participants attained a mean understanding of 79% of the concepts identified as necessary after experiencing two approaches to teaching the polymerase chain reaction. The science-in-fiction group scored slightly better than those who experienced the PCR hypermedia program first. Significant conceptual change about the nature of science was not detected, even though most students demonstrated deep and/or elaborative learning styles.


Six teachers who were in their first, second, or third year of teaching participated in this qualitative study. Findings include changes in the beliefs and pedagogical style of the participants. Follow-up workshops during the academic year were shown as creating opportunities to refine interpretations of extended inquiry from a base of practical classroom experience.

This study documents a year long Teacher Professional Development Program (TPDP). The objective of the TPDP was to make science instruction more frequent, active, and student-centered in the school. The results show that teachers, administrators, and parents were satisfied that the objective was met, and that the TPDP contributed significantly to this outcome.


Analysis indicates that both groups scored low on the initial mastery test, but do significantly better after completing both treatments. The discussion of each treatment highlights the strengths of each treatment approach and recommends starting instruction with problem-oriented activities to frame a need to know more through inquiry activities.


This study considered results for 54 teachers and 2,330 biology students. The teachers in the study attended Project ‘Genetics’ workshops. Case studies and the Decision-Making Model allowed students to perform essentially the same on the student post-test as those students who did not use them and also gave them the benefit of practicing skills in bioethical decision-making.


The independent variables were test, gender, ethnicity, and grade level. A stratified random sample (N = 2400) was selected from a national pool of norming data. The factors yielding significant results were ethnicity, grade, and ethnicity by grade. No significant differences were found between female and male achievement on the performance-based assessments.


The participants in the collaborative program under study came together for many different reasons and had different ideas about how a relationship should be conducted. This created issues that affected the development of curriculum and instruction. Issues involved the lack of mutual respect for the work of the partners, understanding about roles and responsibilities, a clear and understandable goal, and time to collaborate.


Two structural overview conditions were crossed with two control conditions. No significant differences in scores for either variable or for their interaction was found. Learner-control subjects receiving the structural overview deviated from the linear path significantly more often than subjects who did not have the structural overview, but deviation from the linear path was not associated with higher posttest scores.


Analysis of the data indicates no difference between females and males concerning factors
that influenced them to enroll in TAMS. Both females and males in TAMS ranked extrinsic interest including job opportunity, salary, and promotion, as the most important factor. The least important factor for both females and males was family encouragement.


This dissertation examines the role of technology as curricular content in school science. It contends that the introduction of applications of science in students' everyday lives requires a different kind of subject matter knowledge than traditional scientific knowledge. It is argued that school science knowledge has been the product of views of science which have overemphasized abstract over practical knowledge, erasing most traces of technology from the curriculum.

tec, cur, int, ped. str (K-12)


A program to increase parental involvement was designed and implemented in five college prep chemistry courses. The time that parents and students spent conversing with each other about chemistry increased somewhat. Parents thought involvement was beneficial and made suggestions for improvement. Students resisted having to work independently but thought it was a unique, beneficial experience.

che, cid, bkg, ped, cpl (HS)


This study evaluates implementation of the Idaho Virtual Classroom (IVC) Electronically Distributed Learning Environment (EDLE) in meeting the goals of flexibility, critical thinking, and cognitive interaction. Findings indicate that flexibility in time and space were provided by the IVC EDLE and critical thinking and cognitive interaction were successfully facilitated.

cur, cbi, pbs, ped (HS)


Students used an instructional strategy in which they independently constructed propositions from laboratory concepts and used them to form concept maps. Emphasis on proposition formation prior to concept map construction was shown to aid knowledge construction especially in relatively balanced student pairs.

lab, kns, ens, rem, cpl, bio (PS)


This study hypothesized that the use of constructivist learning methods which involve analogies would improve text learning and motivation to learn. The results indicate that the sixth graders in the analogy condition had significantly higher recall than the sixth graders in the control condition.

ens, lrg, ats, ped, kns (MS)


This dissertation explores the usefulness of graphical representations in teaching students about scientific arguments. The development of a representation, by forcing a deeper analysis, can potentially yield a greater understanding of the domain under study. Results varied depending on the graphical representations used.

rem, lrg, ped, cbi, nas (PS)

This study investigated the use of repurposed content-rich entertainment videos (versus traditional educational videos) presented in either an active or passive educational setting. The results of the study indicate that the use of content-rich entertainment video may provide an effective alternative for science education.

ped, ed (MS)


The primary reason for doing the study was to assess potential for increasing EE in elementary school by means of preservice teacher training. The findings of this study indicate that preservice teachers moderately agreed that their actions to offer EE could bring desirable outcomes in EE; they possess positive attitudes and perceptions regarding EE.

att, ene, tpd (TE)


The teachers (n=6) participating in this study used worksheets for instruction in the topic they had studied in the institute, and all had adopted the practice of oral 'check-outs' modeled during the institute. Teachers varied in implementation of other inquiry teaching techniques, with the high school teachers following the model from the institute more closely than the middle school teachers.

inq, tpd, phy, ped. cur (SE, TE)


This dissertation investigates the history and legacy of modern China's leading institution of advanced research, the Academia Sinica. The history of Academia Sinica is not simply a narrative of an institution, but the story of an important group of Chinese intellectuals and their interaction with the government at a critical juncture in twentieth-century Chinese history.

his, sts, nas (GEN)


The hypotheses for this investigation involved the relationship between regular university students and university extension students at Shih Chien University and its educational extension institute in Taiwan. The results of the study showed no significant relationship between SDLRS and resource support in the two groups.

chs, sks, ats (PS)


The purpose of this study was to compare student achievement in a high school physics unit on pressure using two different teaching methods. This study did not reveal extreme differences between the groups, but some key points can be noted. The test group showed more thorough understanding of the concepts and were able to apply these concepts in new situations.

inq, ach, phy, ped. kns (HS)


This study examined computer simulations within a conceptual change learning environment and compared it to more lecture-centered, traditional ways of teaching. Results indicated that the treatment group significantly outperformed the control group on the achievement test, and
had a higher rate of improvement on two subscales: Isolation of Variables and Abstract Transformation.

cbi, cns, phy, ceg, ped, ach (PS)


Results indicate no significant differences in the Test of Science-Related Attitudes scale or biology knowledge between the cooperative learning group and the control group. Analysis of the research data did not show any significant correlation between attitudes toward science and biology knowledge.

cpl, ats, ach, lab, bio (PS)


Using the Academy's process of development as a model for creating other schools, conclusions are drawn and recommendations are proposed regarding seven key phases of development in the creation of a school. Issues are identified which could prove to be useful to educators involved in or considering the development of a new alternative school.

his, ref, cur (SE)


This qualitative study explores how science instruction can develop student questions into centerpieces of ongoing classroom inquiry. Active collegial dialogue, teacher research methodology and a reflective journal provide multiple perspectives for this exploration and establish the foundation for defining further questions.

inq, ped, tpd, skt (TE, HS)


The purpose of this study was to gain insight into elementary teachers' perceptions about current science reform goals and their thinking about factors that might facilitate and constrain them in this rural setting. The results suggest that these teachers felt uncomfortable teaching science, believing they lacked the ability to be quality science teachers.

att, ref, skt, tpd (EL)


The data indicate that the participants had experiences with nature prior to their W.H.E.P. participation and the greater the participants' experiences with nature the less competitive they were in the Alabama State W.H.E.P. contest. There was also shown to be a symbiotic relationship between the Tbilisi objectives.

en, ndl, tpd, cht (TE)


Student success was evaluated by their performance on laboratory activities, a hands-on assessment, and an objective unit test. Results of these assessments indicate the students made connections to other scientific disciplines and were successful in applying learned concepts to new problems. Also, results suggest that students function and learn better in inquiry activities that provide some structure.

int, inq, cur, bio, che (HS)


Results revealed no significant differences in the achievement of students in the control and experimental groups. Analysis revealed that
students who experienced no mapping consistently rated the instructor higher than did students who experienced instructor mapping. Students who cooperatively constructed cognitive maps reported the lowest scores on the opinion polls.

*ats, ach, ped, cns, cpl, gen (PS)*


This research sought to determine whether reflection prompts promote knowledge integration and what level of prompt specificity best supports students in that endeavor. Instructional designers should concentrate on building learning environments that provide opportunities for students to reflect, and allow students to take responsibility for directing their own reflection autonomously.

*ped, lrg, cbi, phy (MS)*


Seventh and eighth grade students (n=169) were randomly assigned either to a published technology education program or to control curricula. Pre- and post-test instruments assessed technical/scientific self-efficacy and career interest. No treatment effects were found. A demand measure showed significantly greater valuing of the technology program over the control curricula.

*cur, tec, ats, car (MS)*


The purpose of the study was to investigate sixth-grade students’ (n=16) alternative conceptions regarding fossil fuels and issues relating to their use. The findings indicated that students' own interpretations of these fossil fuels resulted in a diverse set of unintended learning outcomes.

*alf, lrg, ceg, esg, ene, kns (MS)*


The study examined whether student teachers who took methods courses via interactive instructional television received instruction about hands-on activities, and whether they used the activities when they did their student teaching. The study finds that if the instructor models hands-on activities in the television broadcasts, then student teachers are more likely to use them in the classroom.

*edt, hos, skt, ped, tpd, kn (TE)*


The stoichiometry unit project is a chemistry unit that has been reconstructed to incorporate different teaching strategies embracing all of the different learning styles of the students. Test scores and unit scores were compared to those of a previous year. The difference was not statistically different but overall grades did improve. Students’ attitude towards learning also improved.

*isy, ats, ach, cur, che (HS)*


This study examined the effects of constructivist instruction on 67 third grade children’s conceptualization of force as compared to the instruction based on text and demonstrations by the teacher. Results showed that more than half of the children in the experimental group moved to a higher level in the posttest than did the control group.

*cns, kns, ped, ceg, phy (EL)*

The study examined how teachers identify and react to student ideas and how their responses impact students' learning. Implications are that children's ideas do play a role in teaching by influencing planning of lessons, encouraging teachers to seek ways of responding to student ideas, forming a basis for dialogue and discussion about science, and informing teachers of areas for improving their own content knowledge.


Interest in environmental issues, the challenge of solving problems and a desire to make a difference were factors identified as influencing selection of this major. Environmental career attributes which influenced choice were variety of tasks and use of science skills. Faculty advisors recommended the ES major to students who demonstrated a clear interest in natural resources.


When science was moving gradually toward a public enterprise from the early seventeenth century, the passive voice gradually replaced the active voice in science writing as a dominant stylistic feature. The passive voice is thus historically and socially conditioned. This work argues that undergraduate science teachers need to emphasize writing practice to have students use passives rhetorically to present experimental processes, materials and methods.


The results support a representation of physics knowledge based on both theories and models. The novices' hierarchy of models is a sub-set of the experts' and intermediates' hierarchies indicating that these models exist for experts and intermediates within the scope of the theory. The final representation is a hierarchy of models from general to specific connected and encompassed by a particular theory that can be used to create the models.


Results indicate that abilities to imagine relative motion and to visualize from different points of view within a three-dimensional field are important to the understanding of concepts related to earth motions. Some of the same abilities appear to be utilized in the rendering of perspective drawings. Teachers are encouraged to include the drawing of three-dimensional fields in science class.


The purpose of this research was to develop an instrument to examine the construct of Community Understanding (CU) and to use the instrument to look at correlations between CU and environmental attitudes and action. Results indicate that research into CU from the standpoint of environmental attitude and action could contribute to knowledge needed to advance the cause of environmentalism in the educational process.

The treatment included a training session in the use of Science Helper, followed by finding appropriate lessons to form a science mini-unit. The results did not find significant differences between pretest and posttest scores for the treatment group. The results of this study suggest caution in expecting too much from the affordances of a resource alone.

ddt, skt, tpd (TE, EL)


This research focuses on the influence of inequitable science teachers’ beliefs and actions on the learning of African-American students. Teachers’ beliefs and action produce uneven distribution of opportunities to learn science that are contributing to inequitable outcomes. This study seeks to further the understanding of teacher change towards equitable teaching.

att, eqt, eth, tpd (TE, HS)


The treatment group used a molecular modeling program and the control group did not. The use of modeling enhanced the conceptual understanding of the treatment group at the molecular level through their ability to manipulate images in three dimensions. Students reported advantages for both computer-generated and physical models.

cns, rem, chi, che. lrg (PS)


This study of men and women college students who all had high mathematics ability showed that there were no gender differences in course selection, attitudes towards mathematics, and career choice. This suggests that women with high ability in mathematics are just as likely as men to pursue interests in mathematics and related courses in college and in selecting careers.


Teachers continue to teach science in the way they experienced it or were trained. Few have used the concept of alternative assessments or lab activities. Teachers who had science endorsement reported using fewer process skills and those who have entered teaching from private industry demonstrated great background knowledge yet little participation in inquiry oriented activities. Those teachers who had been exposed to the NSES did describe assessment practices from the standards.

asm, nas, ref, cur, lab. inq (TE, MS)


Nonselectors and selectors of elective science were influenced by various external factors. Nonselectors chose to select the minimum number of science classes necessary for graduation. Selectors were influenced by curriculum requirements, future concerns and mentors. Special programs that required extra science classes were influential in students' decisions. Gender differences were not influential.

ats, bkg, car, cur (PS)

Students within the experimental group spent five minutes at the end of each class for freewriting about concepts presented that day. Students in both groups began each unit of study by creating a concept map and taking a pre-achievement test. Results show a significant interaction whereby journal writing did affect a positive increase in conceptual change when compared to students not using journal writing.


The study provides a reference to better judge the prerequisite skills, knowledge and attitudes that students should attain before enrolling in chemistry. Twelve factors (6 demographic, 3 cognitive and 3 affective) emerged as significant predictors of success. There were differences in which factors emerged based on the type of institution and on how student success was defined.


Given the present context of classrooms coupled with the radical changes in science teaching that are called for today, it has become critical to understand how teachers see their practice, how they talk about it, how they make sense of the dilemmas they encounter, and how they use their knowledge of teaching to improve their practice in the face of these challenges.


Participants reported a reduction in their perception of barriers to the incorporation of evolutionary theory, both on post-institute surveys and post-delay (final) surveys at the end of the academic year. Six of ten 'perceived barrier categories' showed a significant decrease. 'Lack of time,' 'personal inertia,' and the 'controversial nature of the topic' were identified as the most persistent barriers.


Conclusions indicate that an in-depth knowledge and passion for science, students, and teaching drives science-eyed teachers. She organizes curriculum and instruction with scientific principles and skills of inquiry in mind and improvises lessons to meet students' needs and interests in science. She seeks out other science-eyed teachers. She is unique, inventive, and self-aware.


This study examined how participation in an institute which provided a constructivist learning environment affected the interactions between teachers and students in elementary science. Results indicated that the women interacted approximately twice as often as the men. An experience that provides a constructivist learning environment for participants may be effective in helping teachers to transfer the experience to their classrooms or in reinforcing and validating teachers' current practices.

Students receiving traditional pedagogy scored higher than students taught by constructivist pedagogy on the science achievement posttest. Scores of constructivist students showed a slight increase on the delayed posttest, while traditional students' scores decreased. Those receiving constructivist pedagogy had higher retention, approaching significance of the biology concepts tested over time.


Conclusions drawn from the data indicate that Summer Science Exploration Program helped participants maintain a high level of interest in science. In contrast, students who applied but were not accepted showed a decrease in their attitude towards science and their interest in science careers over time, compared to the participants.


The study of the structure and composition of networks among individuals and school groups provided insight into how media are implicated in the development of resource networks, in particular for a subset of students who have been underrepresented in science—young ethnic minority women.


This study found that students involved in the Minority Engineering Program had first quarter grade point averages exceeding those of their peers in earlier years prior to the program's existence.

Graves, A. Palmer. (1997). An investigation comparing traditional recitation instruction to computer tutorials which combine three-dimensional animation with varying levels of visual complexity, including digital video, in teaching various chemistry topics (The University of Oklahoma). DAI-A 59/11. p. 4099, May 1999. [AAT 9911861]

The simultaneous presentation of digital video, showing the solid to liquid phase change of water, with a molecular animation, had a significant effect on college chemistry student particulate understanding when compared to traditional recitation.


This study included a validation of an instrument, Depth of Understanding Assessment, by examining 230 eighth grade science students. There was a significant difference in depth of understanding which favored both the constructivist group and females. Students in the constructivist group perceived their learning environment to be more constructivist than students did in the objectivist group.


Results indicate that beginning teachers enter the classroom with images of their role in the
classroom that are influenced by preservice programs. Those images, however, are not always clear and clarity was an influential factor in the participants' ability to implement the knowledge and skills they had examined in their preservice program. The results further indicate that beginning teachers who come from the same preservice programs enter their first year with a variety of images of teaching.


The results of this study indicate that educators must first change their pedagogical and theoretical frameworks for teaching science to establish a classroom environment where thinking in all its forms is cultivated. Second, the results support modeling, discourse, cooperative learning, and lab and hands-on activities as useful methods for facilitating creative and critical thinking.


Three exemplary high school biology teachers used metaphors (nurturer, provider, inspirer) to describe their teaching practice. These metaphors were stable over time and impacted several aspects of their practice.


This case study demonstrated that professional growth can occur when teachers interact collaboratively using telecommunications. Teachers from different summer institutes, who had never met, interacted as a community. Findings suggest that telecommunications is an effective option for sustaining collegial interactions and providing support.


The College of Sciences and Mathematics Science Outreach Initiative was a summer program designed to attract students with the interest and ability to succeed in science and to keep them interested until they entered college. Analysis of Summer Science Camp Survey data (n=48) with paired samples (n=43) revealed that interest and self-efficacy significantly increased after Summer Science Camp.


Science curricula at two schools with widely divergent demographics were different. These differences included social discipline, knowledge segmentation and reconfiguration, time and pacing, control of bodies, and testing, and the formality and intensity with which the curriculum was conducted.

Hefty, Eunice Ann. (1998). Examining motivations, efficacy and interest in graduate study among teacher participants of a summer institute (The University of Texas At Austin). DAI-A 59/09, p. 3356, Mar 1999. [AAT 9905751]

This study examined changes in self and general science teaching efficacy of teachers attending an environmental sciences summer institute in which they earned three hours of graduate credit. Teacher participants' apparent motivation(s) to attend in the absence of state and district mandates were also examined. The data revealed an increase in science teaching efficacy on posttests.

This study found that students' attitudes toward science are positively influenced through the conceptual change teaching method by enabling students to: (1) choose problems and find solutions to those problems (student directed); (2) work together in large and small groups; (3) learn through student oral presentations; (4) perform hands-on laboratory experiences; (5) learn through conceptual understanding, not memorization; and (6) implement higher order learning skills to make connections from the lab to the real world.


Student thinking can be challenged and students can connect their knowledge of functions generated in one representation to another. Use of the dynamic physical models enabled students to interpret functions as repeated actions with several students constructing generalized interpretation of the process. Instruction incorporating the use of dynamic physical models is indicated and recommended.


This study examined the degree of student learning in ecology when using problem-solving techniques. Students were given an active role as they were presented with questions, then discussed the ideas being presented, decided what notes should be taken, and designed their own procedures to solve the problems. Upon comparing the pretest and the posttest results, a substantial increase in objective scores was noted, and the data were supported by statistical analysis using a t-test.


Participants (n = 518) were recruited from two sections of an introductory biology course. A factor analysis demonstrated four factors underlying epistemological beliefs (certain knowledge, innate ability, quick learning, and simple knowledge). A correlational analysis indicated a significant relationship between epistemological beliefs and strategy use. Epistemological beliefs and strategy use contributed a statistically significant amount of unique variance in SAT Verbal score, college GPA, and course grade.


This study assessed the perceptions that Oklahoma Public School Superintendents have of Applied Biology/Chemistry and Applied Physics (Principles of Technology) compared to the traditional format of science courses.


The study examined the nature of how children make sense of phenomena in the area of genetics and inheritance in terms of five aspects (cognitive, affective, social, playfulness, and mode of awareness). In addition, the importance of considering language aspects of science learning was an emerging issue. Students' talking about genetics was embedded in the larger framework of social relationships and social institutions.

This study examined the graduation rates of minority college students (N=101) majoring in the sciences. Socioeconomic status and GPA were found to contribute significantly to the graduation rates of minority students majoring in all sciences when combined with chemistry. Gender, high school GPA, SAT Total Scores, class rank, and socioeconomic status did not contribute significantly to the graduation rates of minority students in biology and pharmacy.


This thesis describes an action research investigation of improvements to instruction in General Chemistry at Purdue University. This study was conducted to guide continuous reform of materials delivered via the World Wide Web by involving students, instructors, and curriculum designers. Students were able to learn chemical concepts that utilized 3-dimensional visualizations, but not textual and graphical information delivered via the Web.


Mean scores of the Second International Science Study test for 1,984 Yemeni students were 11.93 out of 35 items for science track students, 9.21 for three-year teacher training institution students, and 8.49 for five-year teacher training institution students. Fifth and ninth grade students’ scores ranked at the bottom of scores of students from 15 and 17 other nations respectively.
Department of Agriculture, Agricultural Research Service. The prevalence of conceptual isolation and epistemological confusion among members of the Rhizobotany Project demonstrated the instability and inconsistency of science students’ and researchers’ epistemological commitments and beliefs.


This study analyzed the relationship of concept mapping to science problem solving in sixth grade elementary school children. Results from the analysis of covariance showed that the group receiving instruction in the concept mapping format performed significantly better than the group receiving instruction in traditional format.


This qualitative multiple case-study described and explained the nature of the laboratory learning process among small groups of undergraduates at work in introductory biology teaching laboratories through categorical and interpretive analysis of small group discourse, staff interviews and student lab work products. Instances of learning in the epistemological, social/affective, and ontological dimension were documented as question/answer loops.


The effects of writing to learn were investigated with 24 high school physics students. Results indicated no significant difference between groups writing personal analytic and formal analytic essays and no significant effect of writing apprehension on essay quantity. Significant differences appeared on application and concept questions when group performances were analyzed in terms of essay word quantities.


The purpose of this research was to describe the environment in which research science faculty commit to teaching. The department’s history and faculty’s perceptions of teaching play an important role in faculty commitment to teaching. Collaboration with their peers and informal relationships, support staff contributions, interactions with graduate students, and administrative actions through tenure and merit increases influence faculty commitment to teaching. The role of Chair is pivotal.

int, sks, phy, lrg (HS)

An identified exemplary science teacher who teaches in an elementary school in Taiwan, Sam-Yu, was the subject of this study. Sam-Yu had a blend of views on the nature of science and a varied knowledge about science pedagogy. Personal preferences, past experiences, and the national science curriculum all played important roles in the refinement of Sam-Yu's beliefs about science and pedagogy.


Three science teachers were interviewed to explore their views of creativity and science pedagogy. Results indicate that science teachers' limited views of creativity can affect their pedagogy. The science teachers shared the commonly held belief that science and creativity are mutually exclusive phenomena.


To determine what would increase students' attendance at a nature preserve, factors that may affect elementary private and public school principals' and teachers' decisions to support field trips were identified and compared.


Data on completion of high school chemistry courses were disaggregated, analyzed, and compared with grade performance in first-year college chemistry. Completion of any level of high school chemistry failed to correlate with academic performance in college chemistry. Positive correlations were found between test scores and course grades with the mathematics section of the MEA and with both portions of the SAT.


The purpose of this study was to examine the instructional effects of different computer models (i.e., text with static models and text with animated models) of plate tectonics on undergraduate students' (n=90) learning of geology concepts and attitudes towards Computer-Assisted Instruction. Students using animated visuals did significantly better than students using static visuals with respect to knowledge of plate tectonics, but they did not make a significant difference on subjects' attitudes in this study.


This study investigated changes in preservice secondary science teachers' conceptions of the nature of science during a college level secondary science methods course as assessed through concept mapping. Preservice teachers' concept maps showed a statistically significant gain in acceptable concepts, vertical links, levels of hierarchy and total scores of acceptable components.


This dissertation examined the historical role of technology (movies, television, and the computer) in science education. The convergence of the
various technologies into a single entity represents one likely scenario for the use of technology within science teaching. Further developments with telecommunications may provide simple and direct delivery systems for national and/or state curricula.


This study examined the frequency of calculator and computer use among a nationally representative random sample (n=11,000) of U.S. high schools. Frequency of calculator use impacted mathematics and science exam scores, but mathematics students using computers 1-2 times per month scored significantly higher scores than students using computers almost every day.


This study explored philosophies, life experiences, educational preparation, classroom techniques, and perceived limitations of successful teaching practice for six middle school science teachers. Six themes emerged: Personal and Philosophical Characteristics of the Participants, Teacher Preparation and Life Experiences, Philosophies of Science Teaching, Successful Techniques for Learning, Barriers to Effective Classroom Practice, and Pathways to Success.


This study compared different methods of alternative clinical experience; family science nights and Saturday science (authentic teaching) against micro-teaching (peer teaching) in terms of self-efficacy in science teaching and teaching self-efficacy. There was no significant change in the overall means for science teaching efficacy for any of the groups and the mean scores for all groups dropped for personal science teaching efficacy.

**Knappenberger, Naomi.** (1998). *The effects of the interaction between cognitive style and instructional strategy on the educational outcomes for a science exhibit* (University of Virginia). DAI-A 60/01, p. 65, Jul 1999. [AAT 9916324]

This dissertation examines factors which may affect the educational effectiveness of science exhibits. The results of a multiple regression analysis indicated that there was a significant interaction between cognitive style and instructional strategy that affected visitors’ posttest scores on a multiple-choice test of the content.


Secondary school physics textbooks and laboratory manuals were evaluated for gender balance. Only two textbooks had a balance of men/women, boys/girls in the illustrations, drawings and photographs, while all textbooks were gender balanced for accomplishments of scientists. All laboratory manuals had skills and motivating factors important to girls.


This study examined the effects of the new curriculum on achievement and general attitude of suburban college-preparatory high school chemistry students. The results indicate that there are some positive trends in both achievement and attitude resulting from the new curriculum.

This case study revealed the underlying relationships between teachers' conceptions of the nature of science, their understanding of their role as science teachers and their expectations for appropriate and worthwhile student learning, and to describe the influence of these factors on their curricular choices within the project-based framework.

n, a, t, c, l, r, p (TE)


This study examined social factors affecting the educational and career aspirations and choices of academically talented students—drawn from summer science, mathematics and engineering programs—who are at the initial stages of pursuing a career in science and technology. Important differences between girls and boys in identity processes were found. Suggestions for improving retention of talented students are made in light of these findings.

c, a, g, e, q, s, c, t, s, b (PS)


This study explored an Internet-delivered professional development experience, which utilized multiple session interactive real-time data sources and semester-long sustained telementoring. Findings suggest that science teachers benefited from a sustained coaching experience for inquiry-based lesson delivery and preferred the telephone as a coaching tool for its efficiency and convenience.

in, c, b, t, p, d, p, d, a, t (TE)


From this study’s survey results, it was found unlikely that educational technology will be used more in science classrooms unless teaching strategies such as constructivism are utilized to link science students with educational technology.

ed, p, c, r, s, a, t, k (SE)


To motivate the students and help solidify concepts, student-directed, hands-on, visual, and relevant laboratory experiments were incorporated into science lessons. The evaluation instruments indicated that scores were the same as those achieved in other units, but long-term retention was considerable, as indicated by posttests and interviews.

c, h, o, s, l, r, p, d, i, q, s, a, b (SE)


This thesis presents an analysis of 1996/97 survey research data regarding the relationship between Teton Science School (TSS) programs and classroom teachers' ability to teach about the environment. Teachers who participated in TSS programs reported doing a great deal of teaching about the environment and having a positive attitude toward environmental education.

t, p, d, a, t, e, n, e, k (TE)


This study investigated a summer institute for science teachers and Native American para-professionals and students in the Department of Chemistry at the University of Washington (UW) from 1992-1996. An Advisory Board that included equal representation of Tribes and Elders, families, school personnel, and University representatives
designed and monitored the program, and considered the effect on the students of every decision made.


This paper assessed how effective the La Selva, El Mar, El Bosque, y El Desierto project was in helping upper-elementary English-only students (n=17) learn about animals and their habitats in Spanish. The results indicated a statistically significant gain between pre- and posttest scores.


The present study was designed to evaluate the impact of an experiential science program, EarthWorks, on fourth-grade students' understanding of ecological science and feelings toward science. The statistical analysis of students' understanding of key concepts related to ecology and students' feelings about science identified areas of statistical significance.


In this study of preservice teacher knowledge and pedagogical content knowledge of elementary mathematics and science, an extensive acquisition of teacher knowledge and pedagogical content knowledge was discovered through identified learning components. Patience, flexibility, and communication were identified as necessities for successful teaching.


This study investigated the effectiveness of an innovative distance-mediated mentoring program for rural novice mathematics and science teachers. Impact on mathematics and science teaching was accomplished by: sharing materials and activities; planning units and projects; locating resources; classroom and student concerns; long-range curriculum design, and improvement of teaching practices.


This dissertation explored how different stakeholders of two environmental education programs determined program effectiveness. The results show that all levels of stakeholders perceived the two programs to be effective. A preliminary model for environmental education program evaluation and recommendations for future related research are presented.


PowerPoint presentations were effectively used to introduce, reinforce or review various topics that were studied in College Prep Chemistry classes.


This project investigated the influence of homogeneous review pairs and heterogeneous
cooperative learning groups using computer-assisted instruction on academic achievement and attitude toward science in eighth grade Earth science students. Achievement was not influenced by placement in homogeneous or heterogeneous pairs, regardless of academic assignment.

cbi, cpl, ats, ats, esg (MS)


In the Dynamic Physics learning environment students made above-average normalized gains in physics conceptual understanding when compared with a range of normalized gains from physics education studies. The sample of female students had significantly lower average scores. Groups with one or more female members earned higher averages in group assessments than all male groups.

cbi, ach, gen, cpl (PS)


This study investigated the experiences of secondary students in audio-graphics teleconference chemistry program from the students’ perspective. The results revealed a character profile of the distance learner as one who is organized, responsible, independent, and a mature individual. The majority of distance students attributed to their success in distance education chemistry to level of effort.

edt, lsy, chs, che (SE)


The factors affecting the teaching and learning of evolution were examined in the public schools of Puerto Rico. The teaching of evolution was found to be completely neglected due to the religious beliefs of teachers, deficient pre-service training in particular poor training in history and philosophy of science, and deficient content and methods knowledge. Conceptual change teaching was found to be effective in transforming student views towards more scientific ones.

evo, bkg, bfs, csg, nas, phe (K-12)

Mann, Shelley Donna. (1998). Beliefs to practice in postsecondary science education: The value of research/the research value (Simon Fraser University). DAI-A 60/07, p. 2436, Jan 2000. [AAT NQ37730]

The intent of this study was to examine how beliefs of postsecondary science educators about the nature of science, and of education, influence their pedagogical decisions. Findings indicate that the research culture, so dominant during the teachers’ own education, continued to inform their beliefs, and was revealed in their teaching.

knt, att, nas, res, bfs, tpe (PS)


This study investigated Project Inquiry, a two-year long multiphase study, designed to transform the delivery of science instruction to a hands-on, minds-on, constructivist approach. Results indicated that although there were significant positive gains in physics content knowledge and science teaching efficacy. The overall average gains in physics content knowledge were not predictive of gains in either Personal Science Teaching Efficacy or Science Outcome Expectancy construct.

tpd, ens, inq, phy, att, kns (TE)


This study investigated long-term retention of frog internal anatomy between seventh-grade students (n=280) using an interactive CD tutorial,
a desktop microworld, and conventional frog dissection. There appeared to be a relationship between treatment and gender in terms of effect on science anxiety. For learning gain scores, some cases within the microworld treatment proved to be significant.

**cbl, lab, bio, ats, ach, gen (MS)**


To fill the need for a tool testing introductory, undergraduates' knowledge of basic concepts in electricity and magnetism (EM), the investigator developed a sixty-six item, multiple-choice diagnostic exam (DEEM) that gauged students' pre-instructional and post-instructional knowledge and helped identify common misconceptions.

**alf, asm, phy, kns (PS)**


Preservice elementary teachers' science teaching efficacy and attitude towards science teaching are important determinants of whether and how they will teach science in their classrooms. Findings of this study revealed that prospective elementary teachers in an electronically networked group had better science teaching efficacy and personal science teaching efficacy as compared to the non-networked group of preservice elementary teachers.

**att, utw, tpd (EL)**


This study compares cooperative learning behaviors between a first grade and a fourth grade and founds that first grade students may not be developmentally ready for cooperative learning groups.

**cpl, chs, lth (EL)**


Multivariate statistical analyses found the construction of modern curricular materials is highly sensitive to various kinds of organizational, cultural, and professional linkages to world society. The trends found in science and mathematics are most accurately seen as part of a wider shift in curricular content, cutting across all subject areas and extending through university-level curricula.

**mat, cul, bkg, ref (EL)**


This naturalistic case study examined a reform-oriented preservice science teacher's beliefs and actions during a year of field practice. Inductive data analysis indicated that tacit beliefs interacted with significant events of the field experiences to direct the participant's learning-to-teach process in non-educative ways.

**bkg, tpd, att, ref (TE)**


This study examined the questions of whether students' speech act behavior and language use would vary by linguistic grouping. Second grade Puerto Rican native speakers of Spanish, and native English speakers completed sets of paired, hands-on, science activities.

**mce, cld, cpl, hos (EL)**


Forty-eight sixth-grade students and one teacher at an urban middle school participated in this study of the learning cycle. Individual's
assimilation, disequilibrium, accommodation and organization may not correlate with the phases of the learning cycle.


This study described the policy context, patterns of implementation and individual change pathways of teachers in an inquiry-oriented science program for elementary level school students over a two year period of time.


This study looked at the development of a hypertext multi-media educational computer program. FLiPS (Flexible Learning in the Periodic System) is based on Cognitive Flexibility Theory that emphasizes the use of multiple representations for advanced learning in complex domains.


This study evaluated whether elementary school students would perceive changes in their science instruction when teachers and parents attempted to reform the science curriculum as part of the Science PALs project that encompassed four years. At the 5-6 grade level both male and female students in implement or classrooms responded in the desired direction in 8 out of 10 comparisons.


This study evaluated the effectiveness of instructional materials created for a junior high science classroom as students explored concepts of physical and chemical changes of matter through hands-on laboratory investigations.


This study found that precollege participants held fully formed conceptions of the nature of science, for approximately 40 percent of the premises. Participants held more complete understandings of the nature of scientific knowledge than the nature of the scientific enterprise.


This study explored the nature of children's (Grade 6/7) participation in elementary school science in British Columbia. Canada. Spaces of inquiry were identified within a dynamic interdependence of learners and environment. These spaces were: generative, rehearsal, and performative.


This study examined the effect science-Technology-society issue instruction had on the attitudes of female middle school students toward science in comparison to male middle school students and to female middle school students who experienced traditional science instruction.

This study exposed the variety of perspectives from which teachers (n=17), students (n=349), and museum instructors (n=9) use natural settings associated with museums, arboreta and aquaria to enhance educational experiences. Also examined were obstacles to and reasons for conducting field trips. A model was developed for constructing field trips designed to incorporate unstructured time for students to explore, reflect, and develop relationships.


This dissertation describes the development and pilot-testing of an inquiry-driven science curriculum, The Maudaca Project for Middle School, which is built around investigations of the tobacco hornworm. Results of the study indicated no measurable post-treatment effect on science attitude and dramatic post-treatment improvements in science concept acquisition.


The goal of this project was to enhance teaching style variety in middle school science classrooms by enhancing science teacher awareness of the impact of lesson planning, teaching styles, accommodations of student learning styles, and reflective practices. The project began to move the teaching style paradigm from one that has been teacher centered to one that is student centered.


This paper is the documentation of the process used to develop a 22 acre wilderness area into an outdoor learning center located on school property and utilized by the teachers and students in the school district, clubs and groups within the community, and tourists visiting the area.


This study explored introductory physics teaching using traditional instruction followed by structured small group activities designed to facilitate the learning process for students who find a physics optic (way of seeing) and physics language foreign. Male gains in language clarity were closely coupled with physics learning whereas female gains in the two measures were not coupled.


This dissertation reports on a set of design experiments conducted around 'telementoring,' the use of telecommunications to support the development of mentoring relationships between students in school and adults in workplaces. Teams of students who invested greater effort in sustaining their telementoring relationships were significantly more likely to produce sophisticated arguments about their research.

This study examined an instructional treatment designed to facilitate fourth-grade students' change in science understanding through narrative practice. Also examined was the extent to which students incorporated increasingly complex science content (physics of sound) into narratives. Students in the treatment group outperformed students in the comparison group.

crg, ped, pby (EL)


This study found that the relative order of importance of interest and persistence of females in science were: (1) science teachers, (2) parents, (3) summer/extracurricular science programs, (4) mentors, and (5) media. Results suggest that the discomfort that elementary teachers have in teaching science and the little time spent teaching science minimize the influence elementary teachers have on female interest and persistence in science.

gen, ets, car, bkg (ALL)


This study explored how children develop and construct their ideas and alternative frameworks in science. Alternative conceptions and prior understandings did not disappear as children developed their ideas about light. Ideas were used and reused to provide support the gradual process of cognitive development of children's ideas.

alf, cns, lth, ccr, phe (EL)


This project determined whether middle school students would have an increased awareness and a more positive attitude toward the United States Space Program after being informed of its applied technologies and numerous spinoff products.

There were significant increases between pre and post surveys.

ats, ccr, sts, csg (MS)


This study investigated the effects of a shared, Intranet science environment on the academic behaviors of 9th and 10th grade biology students (N=78). Significant differences were found in problem-solving and metacognitive reflection. Lack of gender differences suggests an equalizing effect from a cooperative, collaborative nature of Intranet environments.

pbs, ntw, sks, gen, ed, bio (HS)


This study investigated the incorporation of reflection and revision in hands-on science instruction that emphasized experimentation using model rockets. Low achieving sixth grade summer school students (n = 23) scored low at first with traditional hands-on instruction but improved significantly upon reflection and revision of their experiments

chs, hos, sks, ped (MS)


Secondary school chemistry teachers (n=303) responded to a survey developed about science laboratory safety. Many indicated that they were not adequately instructed on the collegiate level in science laboratory safety and rely on common sense and self-study.

knt, lab, chs, tpd (SE)

A unit on photosynthesis and cellular respiration was developed for a high school Biology I course. Student scores on the posttest demonstrated a marked increase in understanding of key concepts.


A new unit on sound and music was developed to supplement the existing wave unit in a physics class. Student understanding was increased due to the additional experiments and other activities provided.


This case study examined the kinds of learning opportunities in science provided by an inner-city youth gardening program. Findings suggest that such work was perceived as science only when framed in terms of conducting an experiment, engaging in observations, or implying use of tools and team-work.


This study examined the classroom learning environments and science attitudes of twelfth grade students (n=82) in three science classrooms. Results suggest that science preferred more personalized teacher-student interactions and that more positive science attitudes may result in greater participation in physics classes.


The study analyzed how middle school students learn about human respiration in one-on-one tutoring interviews. All students in this study were successful in constructing mental models of a complex concept, respiration, and in successfully applying these mental models to transfer problems.


This research examined the practical theories of 27 beginning secondary science teachers. Most of the teachers alluded to an Executive-type approach to teaching. Sources of conflict included difficulty with meeting the students' individual needs and the inability to match views of the nature of science with instruction.

Riley, Wayne David. (1998). *Characterizing the successful student in general chemistry and physical science classes in terms of Jung’s personality types as identified by the Myers-Briggs Type Indicator* (Middle Tennessee State University). DAI-A 59/07, p. 2431, Jan 1999. [AAT 9842090]

This study correlated the Myers-Briggs Type Indicator, a measure of students' personality type with performance in general chemistry (n=1041). The data suggest that students with certain personality traits may be favored in a chemistry class due the structure of the instruction and the presentation of the subject matter.


This study found that the number of computers connected to the Internet is presently too small to determine the success of the Tennessee Space Week classroom curriculum. In those schools where the Internet is utilized, coordinators do access and integrate NASA and other Internet
aerospace Web sites within classroom instruction.

cbi, cur, esg (K-12)


This study examined successful authors who sought to simplify scientific material while conserving sophisticated language and complex ideas. This study addresses the gap between children's literature and the popularization of science.

lit, his, sts (GEN)


This research looked at student learning in introductory college chemistry. At first the course served as gatekeeper, by using relative grading, rapid coverage of content, and little attention to student concerns. The consequences of the gatekeeper function were the most serious impediments to student learning of chemistry.

bkg, lrg, che (PS)


This case study explored the instructional and attitudinal changes that accompany the restructuring of the daily schedule into 100-minute periods. Positive attitudes toward block scheduling were found. Test scores and grades were not strongly influenced. Teachers met more of the state science standards and spent more time interacting with small groups during the block schedule.

bkg, ats, ach, cid (SE)


This case study examined the experiences, beliefs, and perceptions of stakeholders in one Texan school district and in the state education agency as they worked toward reform in the secondary science curriculum. Teachers' concerns about their science backgrounds, lack of information about the new approach, and lack of communication posed serious barriers to the success of the reform.

ref, att, cur (SE)


- A model of inquiry as the coordination of argumentative and investigative knowledge was the basis for the design of an inquiry-based curriculum for evolutionary biology using software supports. This design showed improvement in students' use of data in their explanations.

inq, evo, cbl, sks (PS)


This study compared the effectiveness of traditional instruction with University of Washington's Tutorials, University of Minnesota's Group Problem Solving & Problem Solving Labs, and Dickinson College's Workshop Physics in ten undergraduate institutions. The three research-based curricula were more effective for helping students learn velocity graphs, Newtonian concepts of force and motion, harmonic oscillator motion, and interference.

cur, pbs, phy, asm (PS)


This study investigated relationships among students' (n=232) epistemological beliefs and
approaches to learning, and examined the possible influence of teachers' (n=5) implemented instruction on students' beliefs and learning approaches. Students who believed in an external knowledge authority were more likely to memorize information than to 'make sense' of information.


This thesis compares curricular and textual documents from Germany/Bavaria and Canada/Manitoba with regard to the central topic of heat and temperature. This comparison revealed the importance of recognizing the differences in age and societal background when selecting concepts.


This study determined the priority environmental management training needs (drinking water, wastewater, and solid waste), classroom training system preferences and related cultural factors of Native American tribal officials (n=18) with environmental responsibilities living on reservations in the United States.


This case study of a teacher found six influences in the development of an inquiry-based science program: colleagues, reading materials, school context, student behavior, the participant observer, and experimentation. Children's literature was integrated with science in different ways for different reasons.


This study of 63 teachers found that English, math, and science share common cognitive skills; physical education (PE) shares common cognitive concepts with math and science; teachers in four disciplines have positive attitudes toward the value of PE, the role of cognitive learning in PE, and integration of PE with other subject areas.


This study found that students had a significantly better understanding of the nature and utility of models after completing the Model-Enhanced ThinkerTools curriculum. Improvements were seen in students' conceptual models of force and motion as well as their inquiry skills and epistemological beliefs about the nature of science.


In this study students (n=495 student pairs) from two middle schools were given a 'hands-on' experience in solving a real-world forensics problem. Approximately twice as many groups correctly solving the problem used an evidence-based approach compared to groups that missed the answer. Trial and error and menu-based were the dominant problem-solving strategies.

Seatter, Carol Eunice Scarff. (1998). An analysis of the concept of teaching in elementary school science

This thesis examines constructivist theory in terms of its potential to hinder the development of scientific reasoning in children. Reasoning in science is compared with children's common-sense reasoning in an attempt to further understand the phenomenon of children's science.

cns, lth, phe, lit, alf, ccg (K-12)


Students were found to have increased their understanding of science based in this brief contact with scientists. Results of the epistemological investigation were inconclusive. Further study, with a larger sample size, was recommended.

nas, ntw, phe, cbi (EL)


Students (N=99) with different backgrounds and with different learning styles learned equally well in Web-based courses. Students were more interested in checking their grades than in communicating with the class and instructors via e-mail, discussion netforum or chat netforum. Motivation and learning strategies explained more than one-third of student achievement

edt, lsy, ats, ach, cbi (PS)


This is a study of the effect of inquiry science activity on the science achievement of junior high school students. Results failed to support the effectiveness of the hands-on science teaching.

However, when teachers emphasized the scientific inquiry skill in the lower grade, the effect of inquiry emphasis had a significant impact.

inq, ach, hos, sks, ped (MS)


This study found that women (N=135) in traditional and nontraditional science majors did not differ on the variables of career self-efficacy, attitudes toward feminism and self-esteem, although nursing students did have significantly higher self-esteem than the nontraditional academic majors and the Occupational Therapy students.

car, gen, ats, chs (PS)


The main emergent findings of this study of preservice teachers were that participants' reflections indicated a focus on student-centered beliefs about teaching and learning. The extent of learning to teach science and putting those beliefs into action depended on the prospective teachers' personal histories as science learners and on their perceptions of the environment influenced by their cooperating teachers.

att, lth, bkg, tpd (TE)


Factors found to influence two teachers as they incorporated new content into their teaching included internal factors: the teachers' past experiences with science, personal content knowledge, confidence, and beliefs about science, learning and science teaching; and external factors: students' abilities, time constraints, and physical classroom limitations.

cur, att, kni, bkg (SE)

This study described high school science teachers' (n=24) perceptions of telecommunications. Telecommunications can be implemented successfully in a variety of high school science classrooms with adequate infrastructure support and sufficient professional development opportunities, including classes taught by females and teachers who had not been computer experts.

**att, edt, bkg, tpd (HS)**


This study developed a better understanding of how technology supports student inquiry in high school science classrooms. The dissertation describes an investigation model that attempts to capture the expert strategies involved in observing and explaining complex, visual processes.

**edt, inq, lrg, sks, pbs (HS)**


This study found a significant relationship between introductory chemistry students' (n=180) understanding of the mole concept and their cognitive level. There was no significant relationship between students' understanding of the mole concept and the type of class, or the number of lectures. Students of all cognitive levels retained misconceptions at semester's end.

**kns, alf, che (PS)**


Results indicate that the Questionnaire on Teacher Interactions is a society/culturally sensitive instrument that needs to be normed to a particular society/culture before it is used to affect teachers' and students' educational environments.

**asm, ats, bkg, cid, eth (HS)**


This essay presents an examination of contemporary disputes over methodological and epistemological foundations underlying inquiry within the field of education research; investigating the obstacles to communication and understanding found in scholarly exchanges occurring across competing paradigmatic orientations. A model of dialogue, based upon characteristics of convergence, divergence, inclusive and critical traits, is adopted and applied to a sample of cross-paradigmatic exchanges found in recent educational research journals.

**res, phe (GEN)**


This study found that despite a low awareness or knowledge of biotechnology, undergraduate students (n>3000) were accepting of specific applications or products of biotechnology. A majority of students identified mass media as their major sources of biotechnology. Students indicated that biotechnology information is needed and is appropriate for high school students.

**kns, sts, lit, bio ats (PS)**


This case study found that student teachers were able to transfer knowledge of inquiry-based instructional strategies into their science lessons. Student teachers in grades four and five believed
they were unable to teach science at the desired degree due to preparing students for standardized tests in language arts and math.

inqu, kat, att (EL)


This study found that students built inquiry understanding by defining problems, constructing models and developing positions, and built epistemic understanding by describing the purposes of models as generalizing phenomena, testing hypotheses and making predictions. However, students demonstrated difficulty in using evidence to defend scientific arguments.

inqu, rem, lrg, sks, nas, tec (SE)


This study reports classroom changes occurring during a case study of reformed science teaching. Changes were informed by student perceptions to assist the reform process, effectively incorporated computer technology into a core academic subject classroom, and resulted in making the learning process enjoyable for students.

ref, ats, cbi (MS)


This study found that college physics students benefited from being taught fewer topics in greater depth in high school physics and from having fewer labs in high school. College females did better than males in non-calculus physics, but this trend was clearly reversed for calculus-based physics.

bkg, gen, ach, phy, lab (HS, PS)


Findings suggest that using a story to explain scientific concepts enhances the retention of concepts. Recommendations are to continue using stories at the elementary level to encourage learning and retention of scientific concepts.

ped, lrg (EL)


Analysis of discourse indicated that middle school students increasingly developed independence from the teacher in selecting, developing, and using material and conceptual tools, built on each other's ideas during discussion and debate, and progressed from describing observations in common sense language to integrating scientific concepts.

cid, lrg, cpl (MS)


College students experiencing the Model-Observ-Reflect-Explain (MORE) classroom achieved significant gains in all areas compared to the control groups. Students in the MORE class recognized the complex dynamic processes typical of scientific practice, developed more sophisticated inquiry skills, and practiced modeling and reflection in the laboratory.

lab, inq, rem, sks, ped, che (PS)


Students had more difficulty solving computerized visual problems compared to traditional problems. Survey responses revealed that students had difficulty determining what
was needed to solve a problem when it was not explicitly given to them in the text of the question. By analyzing think-aloud problemsolving interviews, it was found that multimedia-focused problems required solid conceptual understanding.

pbs, cbi, sks, phy (PS)


This study examined two preservice teachers' knowledge, experiences, and beliefs about science, teaching, learning and the social conditions of schools in the context of a science methods course and student teaching.

tpd, bkg, att, knt (EL)


Support for collaboration and science education reform depended on a district's overall organizational style (classified as top-down, bottom-up, or a combination), was connected to the level of commitment of the sciences teachers and administrators, was linked to the level of solidarity for that support among teachers and administrators, and was demonstrated by the allocation of resources.

att, ref, bkg, ntw (K-12)


This study examined cross-age teaching and its positive impact on the student doing the teaching. This study also measured the achievement of the cross-age student, including demonstration skills, vocabulary, and understanding of subject material being demonstrated.

ach, ped, sks, kns (MS)


Positive attitudes, high expectations, and more intense science course-taking had positive effects on achievement of all students, although they were not equally protective in all social contexts. Effects associated with authoritative parenting and peer influences were negative, regardless of social context.

ach, bkg (K-12)


This study identified conceptions college students used when solving chemical equilibrium problems that applied Le Chatelier's principle. Eleven prevalent incorrect conceptions were identified. Students consistently selected correct answers more frequently (53% of the time) than they provided correct reasons (33% of the time).

alf, che, asm (PS)


This study found that the computer-based drill and practice game of solar system information called Space Colonies significantly increased knowledge of the solar system.

cbi, ach, esg (K-12)


This study examined whether students taught in a more constructivist classroom would have a higher probability of obtaining the correct answer to mathematics items that required a student to reason mathematically. Confirmatory factor analyses were conducted on the multiple choice
items utilized by Third International Mathematics and Science Study (TIMMS) researchers.


High school students (N=174), engaged in computational science project work were the subjects in this study of academic mentoring in a computational problem solving environment. The results suggest that mentored students received significantly higher computational science project scores than non-mentored students.


This study investigated both the extent that the history of science was included in four high school physics textbooks. History passages were found to be aligned with the foci of educational standards. Most history of science examples were superficial, lacking in-depth elaboration, and examples of the process of science made little use of historical approaches.


This study measured the effectiveness of teaching biology using agricultural applications by comparing a treatment group to a control group. Statistical differences were found in the areas of gender, agricultural involvement, perceptions of agriculture, and GPA, but not on performance on the standardized competency test.


This study found that award winning science teachers perceived awards to result from, rather than to inspire, good teaching. Their motivation derived from student achievement and a job well done. Award winners perceived awards as difficult to win, minimally motivating, and frequently causing dissension among peers.


The use of concept maps, as advance organizers, was an effective method for improving student learning in general biology classes. A positive relationship existed between students' cognitive developmental level and conceptual understanding.


Nine grade 12 physics students had experiential knowledge that interfered with conceptual knowledge. Concrete examples did not guarantee conceptual understanding of a given phenomenon. Students used algorithms indiscriminately without knowing if answers were reasonable, plus they did not understand the complex process of vector mathematical representation.

Whitfield, Frank Albert. (1998). *Policy efforts used to develop awareness aimed at increased students' scientific literacy and career choices in mathematics, science and engineering* (Peabody College For Teachers of Vanderbilt University). DAI-A 59/12, p. 4381, Jun 1999. [AAT 9916009]

This study examined a talent pool of African American students who were academically able to pursue a career in a math-based major. Results found that although an appreciable number of students were academically able to enter math
related majors, many were reluctant to choose this career direction.

eth, lit, car, arts (PS)


This study was designed to contribute to current understandings of teachers' perspectives of science education reform, and to describe the relationships between the personal theories about science teaching and learning held by three 'unique' experienced primary teachers and their understandings of a state-level standards-based vision of school science.

att, ref, cur, ped (EL)


This study found that four out of six student teachers studied ranked science third or lower in a rank order of subjects they enjoyed teaching. At the end of their student teaching experience, three of the student teachers were eager to teach science and had a vision of how they would do so, but the other three were not sure how they would teach science.

att, tpd, ped, cur (TE, EL)


This study examined college physics students' (n=25) overall (concept + problem solving + mental model) meaningful understanding of force, density/Archimedes' principle, and heat. Also examined were students' meaningful understanding as measured by conceptual questions, problems, and mental models. Students were able to increase their meaningful understanding.

ith, phy, kns, lrg, rem, alf (PS)


This descriptive study identified factors in site based experiences that affected preservice elementary teachers' (n=131) self-efficacy as measured by the Science Teaching Efficacy Belief Instrument. Results indicate that these experiences had a significant positive impact on the preservice teachers' self-efficacy.

att, bkg, tpd (TE, EL)


Results of this study suggest that computer simulation, clinical interviews, and concept mapping may be an effective instructional method for assessing conceptual development and diagnosing alternative conceptions in undergraduates enrolled in a cardiopulmonary science program.

ebi, alf, asm, kns, rem, bio (PS)


This dissertation developed curriculum materials that replaced traditional recitation instruction and that were designed to facilitate a more complete and appropriate understanding of wave physics. Findings suggest that research-based instructional materials were more effective than the traditional lecture setting in helping students apply appropriate reasoning elements to the physics of waves.

mat, cur, phy, ped, lrg (PS)

This study compared the subject matter presented in a high school chemistry course to the expectations of subject matter knowledge of college chemistry professors teaching a college general chemistry class. Areas where discrepancies existed were identified and solutions proposed.

cur, che (HS, PS)


This collaborative research project involved the design, implementation, and analysis of five sets of performance assessment activities with a group of eight science teachers at an urban composite high school in Alberta.

asm, tpd (HS)


This study was designed to investigate the effectiveness of cooperative learning on the science academic achievement of fourth graders.

cpl, ach (EL)


This exploratory study investigated teachers’ attitudes toward using the Web to share environmental education resources. A few respondents reported that they currently use the Web to find curricular resources. More than 86% of those responding to the Web-based survey indicated that they would visit and use an environmental education Web site designed specifically for teachers.

att, edt, ntw, ene (K-12)


This study proposed, justified, and theorized a cultural studies-based pedagogy for the rhetoric of science that is useful in writing across the curriculum courses. Conceptions of literacy as perceived by humanities scholars and scientific literacy as perceived by scientists and science educators are discussed.

ped, lit, nas, int (K-12)
Dissertations and Theses by Institution

This list consists of 110 institutions that produced research dissertations and theses in the area of science education for the year 1998.

Arizona State University
Burke; Dawes
Auburn University
Cromwell; Dharmadasa; Good; Hauge
Ball State University
D. Brown
Baylor University
Parker
Boston University
Bodwel; Hatton
California State University Dominguez Hills
Lizarzaburu; Waayers
California State University Long Beach
Lemire
Central Missouri State University
Wright
City University of New York
Robin
The Claremont Graduate University
Figueroa
Columbia University
Ealy; Maldonado-Rivera
Columbia University Teachers College
Chou
Cornell University
Iuli
Eastern Michigan University
Kovannis
Florida International University
Almeida; Chung-Schickler
The Florida State University
Eaglin
Georgia State University
C. Carter; Dunkerly-Kolb
Harvard University
Chen; Tai
Illinois State University
Ding
Indiana University
Kao; J. Lee
Indiana University of Pennsylvania
Jolly
Iowa State University
Akpan; Shih

Kent State University
Buck; Grant
Lehigh University
Kostas; K. Lee; Plohocki
The Louisiana State University and Agricultural and Mechanical College
Aguillard; Britton; Wissing
Loyola University of Chicago
Ceates
Memorial University of Newfoundland
Madore
Michigan State University
Alshannag; Cajas; Canestraight; Chorny; Dallas; Decker; Hoikka; Hunt; Lument; Luttig; Morris; Pollock; Pulver; York
Middle Tennessee State University
Riley
Montana State University
Luebeck
North Carolina State University
Johnson; Titus
Northern Arizona University
Dean; Heide
Northern Illinois University
Hines; K. King; Marszalek
Northwestern University
O'Neill; Sandovai; B. Smith
Nova Southeastern University
Nelson
The Ohio State University
Chang
Oklahoma State University
Eskridge; Horn; Robertson
Oregon State University
Barrett; Dickinson
Pacific Lutheran University
Halsted
Peabody College For Teachers of Vanderbilt University
Whitfield
The Pennsylvania State University
Crane; Hug; Mackin; McLoughlin; Sillman
Portland State University
Schepige
Purdue University
W. Hunter; Jones; Zerbe
Rensselaer Polytechnic Institute
Bauchspies; Marx
Rutgers the State University of New Jersey - New Brunswick
Beeker; Novemsky
San Diego State University
Figueroa
San Jose State University
Cody
Simon Fraser University
Mann; Seattter
Southwest State University
Nieland; Ostgaard
Stanford University
McEneaney
State University of New York at Binghamton
Firenze
State University of New York at Buffalo
Aguirre-Ortiz; Dudley; Guarino; McPhail
State University of New York at Stony Brook
Ely
Texas A&M University
Foster; Lowery; Rearden; Sohan; Sopko
Texas A&M University-Commerce
Essary; Wells
Texas A&M University-Kingsville
Schieyer
Texas Southern University
E. Hunter
Texas Tech University
W. Smith
Texas Woman's University
Allan; Baucum; McCammon; Taylor; Turner; Wood
The University of Akron
Marion
The University of Alabama
Dawson
University of Alberta
Wozny
The University of Arizona
Nass; Slaughter
The University of British Columbia
Brigden; Brooks; Mueller
University of Calgary
Jasper
University of California Berkeley
Adams; Bell; Davis; Schwarz; Tien
University of California Los Angeles
Osmundson; Scott
University of Central Florida
Jadonath; Steffy
University of Cincinnati
Orloff
University of Colorado At Boulder
Rahm
University of Florida
Dwyer; Raiford
University of Georgia
T. Carter; Holschuh; Wieseman
University of Houston
Bailer; Harrell; M. King; Mullinnix; Slough; Wingfield
University of Idaho
Carr; Klett
University of Illinois At Chicago
Shimizu
University of Illinois At Urbana-Champaign
Huang; Mishra; Walker
The University of Iowa
Brookmeyer; Guilbert; Monhardt; Ollerenshaw; Robinson; Trax; Weld
University of Kentucky
Ballard
The University of Manitoba
Sawatzky
University of Maryland College Park
Saul; Von Secker; Wittman
University of Massachusetts
Gibson; Keller; Rea-Ramirez
The University of Michigan
Bos; Breen; Luera; Spittinuk; Templin
The University of Mississippi
Dardis; Hulley
University of Missouri - Columbia
Brent; Y. Kim; Loman
The University of Nebraska - Lincoln
Dierberger
University of New Hampshire
Laba; Moss
The University of New Mexico
Wallace
University of New Orleans
Gatlin
The University of North Dakota
Willcox
University of North Texas
Burns
University of Northern Colorado
Shaklee; Voska
The University of Oklahoma
Graves; McWhirter; Saunders; Williams
University of Pittsburgh
Cavalli-Sforza; Feather
The University of Regina
Wessel
University of South Dakota
Chien
University of South Florida
Cavanaugh
University of Southern California
Merkel; Wang
The University of Southern Mississippi
Mullins; S. Smith
The University of Texas At Austin
Arburn; N. Brown; Finley; Hefty; Kaspar; H. Kim;
Klepper; Lyon; Mathew; Salyer
The University of Utah
Hayes
University of Virginia
Knappenberger

University of Washington
Chastain; Freed; Gillette; Little; Ross
The University of Western Ontario
Karrow; Silcox
The University of Wisconsin - Madison
Joseph; Smithson; Toolin
Utah State University
Levy; Warnick
Vanderbilt University
Brophy; Petrosino
Walden University
Bradford
Wayne State University
Ismail
West Virginia University
Saxena
Western Michigan University
Discenna
Trends in Selected Topics of Science Education Research

This section contains a small collection of summaries of research reported in 1998 pertaining to specific topics in science education. Each author chose a particular subject code from the *Key to Codes* (see page ix), considered all of the dissertations, journal articles, and research papers listed in this compilation related to the subject code, and then wrote a brief summary of the documents. In writing the summaries, authors were asked to consider the major findings from research, any issues arising from the current studies (or from a lack of studies), and possible directions for future research. Each of the subjects selected for review in this section necessarily contains a limited number of documents for review and reflects the author's interests. These summaries represent only a sampling of important subjects of contemporary relevance in science education.

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Concept Representation and Modeling in Science

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When reviewing trends in science education research, it is striking to see the variety of models and representations and their diverse applications. The "rem" code used in this book is a catchall for anything that is used or produced by the students, teachers, or software developers to represent their ideas and intangible concepts as well as imperceptible objects and scientific processes. The 1998 science education publications reflect this diversity. Researchers reported how teachers and students use three-dimensional, computer, or conceptual models to analyze students' ideas, improve content understanding, and teach scientific processes. Concept representations were investigated in terms of concept maps, abstract picture language, and visual images. Teachers used these for assessment, advanced organizers, and interview tools. Three emergent themes seem to be that when models or representations are used: (1) students have enhanced learning of scientific principles, (2) students gain an appreciation of scientists' work habits, and (3) these tools can appear in many formats.

Educators have found that models and conceptual representations can make abstract concepts more accessible. Intangible scientific concepts have been a problem for both teachers and students. Whether they are used by children in the sixth grade, community college students, or teachers, research indicates that the tools effectively help users improve performance and decrease apprehension about the scientific concepts (Czerniak & Haney, 1998; Ealy, 1998; Jolly, 1998; Wells, 1998). For example, Czerniak and Haney (1998) examined how teachers anxiety changed as a result of using concept maps in a physical science class, and Raghaven, Sartoris and Glaser (1998) studied the impact of the Model-Assisted Reasoning in Science (MARS) Curriculum on children's understanding of mass.

Several of the studies indicate that students better understand the nature of science if they have the opportunity to interact with models or visually represent their ideas (Kipnis, 1998; Schwartz & White, 1998; Schwartz, 1998; Spitsulnik, 1998; Tien, 1998). The research findings demonstrate that students who have had an opportunity to develop or use models gain an appreciation of the scientific thought processes used to develop models and are able to apply these scientific process skills themselves. In fact, Tien (1998) found that students in the Model-Observe-Reflect-Explain (MORE) classroom were able to improve their inquiry skills and represent their reflections related to laboratory exercises.

Educators have employed or developed models and representations in a variety of formats. In 1998, journal articles discussed how to use computer simulations, abstract picture language, and role playing to explain scientific concepts (Khoo & Koh, 1998; Resnick & Wilensky, 1998; Stylianidou & Boohan, 1998). Several dissertations discussed the use of electronic images to help students understand concepts, such as molecular structures, that would not otherwise have been visually accessible (Ealy, 1998; Graves, 1998; Hunter, 1998). Although many studies investigated new technologies, researchers continued to explore pencil and paper, three dimensional, and conceptual models.

Areas that researchers might pursue in the future include:

- Student generated visual representations for reflection before, during, and after instruction.
- Integration of student reflective representations into computer activities.
- Long term affective and cognitive effects of models and representations.
- Teacher training for the facilitation of student created representations, such as concept maps.

References


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Evolution Education

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Although the number of research studies being conducted in evolution education is small, it is growing. Recent events have shown that the still strong creationist faction is affecting the way we teach science (Moore, 1998a; Moore, 1998b; Moore, 1998c). In the 1997 edition of the Annual Summary of Research in Science Education (Haury & McCann, 1998) there were 3 citations for research involving evolution education. The issues studied were misconceptions, the effect of the creationist movement on science education, and treatment of evolution in textbooks. In 1998 the number of research papers on this topic increased significantly as well as the number of different areas of research interest.

Misconceptions and student knowledge about evolution are still important areas of research (Ferrari & Chi, 1998). The history and effects of the creationist movement on evolution education is also a continuing topic of interest (Rudolph & Stewart, 1998). New topics include those dealing with how to best teach evolution, how evolution is being treated in state standards (Lerner, 1998), and what conditions affect teachers in their approach or lack of approach to teaching evolution.

In light of recent events, two research issues stand out as immediately crucial to our efforts in science education: teachers' knowledge and beliefs about evolution, and identifying effective instructional techniques for presenting evolution. Teachers have been shown to have generally poor backgrounds in knowledge about the topic of evolution. Many pre-service teachers as well as practicing science teachers consider themselves creationists (Aguillard, 1998). They feel that unless they can at least teach creation and evolution equally they cannot teach either.

This issue relates to state standards also. Teachers in states with strong state standards in evolution have legal obligations to teach this subject. They are also given a strong argument to use when students and parents complain about teaching evolution. Many teachers do not teach evolution or touch on it only lightly because they are afraid of repercussions from students, parents, and even administration. When standards are strongly worded in favor of evolution they can be used to back up any arguments on what should be taught (Lerner, 1998).

Other important issues fit in the category of how evolution can be taught so that the most students understand the concepts. One of the best texts that came out in 1998 on this topic is Teaching About Evolution and the Nature of Science published by the National Academy of Sciences (Working Group on Teaching Evolution, 1998). Most articles written about this topic are not research articles but "how to" articles taken from journals like The Science Teacher and The American Biology Teacher. These articles provide many hands-on and minds-on activities to use in teaching about evolution.

The research papers tie in with these articles. An understanding of evolution seems to be tightly bound to an understanding of the nature of science. To overcome the faulty science of creationism students need to have a thorough understanding of the true nature of science. They need to learn how to examine evidence and draw conclusions. Sufficient evidence needs to be provided so that students have the opportunity to develop new conceptions to replace their inaccurate conceptions (Ferrari & Chi, 1998).

One other approach that seems to be supported is to let students study the history of the creation-evolution argument (Moore, 1998c). This argument can be examined from two points of view. The historical debates and social issues from the time of Darwin's publication of On the Origin of Species can be studied (Darwin, 1993). Students can determine where the arguments arose and how they changed over time (Rudolph & Stewart, 1998). The other possibility is to have students look at the beliefs of various world religions as they pertain to evolution and the creation of the world (Bartelt, 1998). Both approaches are aimed at opening the minds of students to be more tolerant of alternative perspectives.

The teaching and learning of evolution should be a fruitful area of study for the future. Past studies have shown a great difficulty in teaching true understanding of the concepts. Student misconceptions are abundant
in this area. Teachers need to be given the skills to improve their teaching of evolution as well as their attitudes on how and whether it should be taught (Firenze, 1998).

Areas for future research:

• Changes in state standards involving the teaching of evolution.

• Reflection of standards in textbooks.

• Teacher attitudes and knowledge in the area of evolution education.

• Best practices for teaching evolution.

• Relationship of student understanding to inclusion of religious and/or historical perspectives in instruction.

References


Constructivist Views of Teaching and Learning in Science

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Over the past several years, educational research undertaken from a constructivist perspective has encompassed a wide range of phenomena, from probing the actual content of student conceptions or mental stages to the study of learning environments and "sociological analysis of the microculture established by the classroom community" (Cobb & Bauersfeld, 1995, p. 2). Research relating to constructivism published in 1998 reflects this broad scope of interest as well. Three themes underlying this research seem to be: (1) attempts to further understand constructivism as an epistemology; (2) attempts to further understand constructivist pedagogical practices; and (3) studies of the benefits of constructivist epistemologies and teaching techniques for students and teachers.

One of the issues of greatest importance in science education seems to be found in showing the connection between a constructivist philosophy (epistemology and ontology) and learning (with students) or pedagogical orientations (with teachers). Expounding the epistemological and ontological assumptions of constructivism, researchers and philosophers of science have been expanding the meaning of constructivism from an epistemological standpoint to teaching and learning practices (Matthews, 1998; Rodriguez, 1998; Staver, 1998). Along this line, researchers reported that a constructivist teaching approach has a positive effect on the improvement of students' perceptions of the nature of science (Jelinek, 1998; Lin, 1998). Books and research articles also exemplified local curriculum reform efforts as well as teacher professional development programs that are designed to implement constructivist instructional practices recommended by state standards (Norman, et al., 1998; Shymansky et al., 1998).

Studies on constructivist pedagogical practices have focused on investigating the effects on students' conceptual understanding and achievement of such instructional strategies as collaborative concept mapping, use of analogies, educational technology coupled with social constructivist pedagogy, and hands-on investigations (Ritchie, 1998; Sneider & Ohadi, 1998; Carter, 1998, Morion, 1998); comparisons between constructivist and traditional (or objectivist) classroom environments in terms of student achievement and conceptual development (Chou, 1998; Ealy, 1998; Freed, 1998, Gatlin, 1998); and constructing mental models of students' conceptual understanding (Bischoff & Anderson, 1998; Osmundson, 1998; Rea-Ramirez, 1998; Seatter, 1998). Other studies explored student-teacher interactions during knowledge construction, in which experimental interventions were modeled after a Vygotskian approach or social constructivist whole class discussions (Dawson et al., 1998; Wessel, 1998).

Against this constructivist epistemology as a theoretical backdrop, the effects of constructivist teaching on students' achievement, motivation or teachers' pedagogical beliefs change were also examined. Sample topics included the effects of a constructivist teaching strategy on students' conceptual change or scientific reasoning improvement (students' learning), changes in teachers' pedagogical beliefs under the influence of teacher education programs where constructivist teaching methods are advocated, and the role of language and culture in learning in addition to making connections between multicultural education and sociocultural (or sociotransformative) constructivism (social/cultural issues). Conceptual change research remains a continuing topic of interest but the focus seems to have shifted from documenting misconceptions toward exploring the influences of student epistemologies on the degree of conceptual change and how to facilitate teachers' pedagogical conceptual change or students' conceptual change using a context-rich environment, technology, metacognition, and implementation of a Vygotskian approach (Scott, 1998; Sprood, 1998). Research on instructional strategies, students' conceptual changes, and classroom learning environments also take social and cultural issues into consideration.

On the other hand, there still exists a broad range of interpretation of what constructivism actually is,
and much confusion about whether constructivism is a worthwhile construct. For example, Gough (1998) contends that "methods of constructivism science education research are not applicable to either subjects or subject matters of environmental education" and he recommends poststructuralist methodologies as an alternative framework. Researchers also criticized on both theoretical and empirical grounds the Vygotskian legacy in terms of its application in actual schooling (van der Veer, 1998) as well as the potential of constructivist theory "to hinder the development of scientific reasoning in children" (Seatter, 1998).

Constructivism is a topic that seems destined to remain in the science education literature for some time, with fruitful results. There is certainly much that remains to be elucidated about constructivism, both as an epistemology and as a theory of teaching and learning. Directions or recommendations for future research areas are:

- Relationship between constructivism as an epistemology and constructivism as pedagogical beliefs, among both students and teachers.
- The influences of teachers' constructivist pedagogical beliefs on students' achievement—cognitive as well as social aspects.
- Examples of constructivist classroom environments.
- Model development of constructivist learning situations.
- The influence of constructivist teacher education program on classroom practices as well as students' learning achievement.

References


Computer-Based Learning in Science Education

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The proponents of computer-based instruction (CBI) cite numerous advantages for using computers in the classroom to enrich learning experiences for students. In addition to harnessing the patience of a computer for drill and practice exercises, the use of computers in education has been promoted as a means to transform learning from the memorization of facts to student-centered problem-solving; to increase student motivation through flexibility and choice; and to provide individualized learning through instant feedback. Other proponents of educational technology tout the potential of the World Wide Web to increase collaboration among teachers and students and to provide access to online museums, libraries, and real data resources.

Computer-based instruction was the topic of 50 journal articles and dissertations published in 1998. Over half of the articles and dissertations (26 studies) compared CBI to traditional teaching and found that the use of computer simulations and visual improved student performance on achievement tests. For example, Swaak & van Joolingen (1998) showed a considerable gain in intuitive physics understanding after students completed a computer simulation on oscillation and several studies (Ealy, 1998; Graves, 1998; and Hunter, 1998) indicated that molecular modeling programs enhanced student understanding in chemistry.

Other studies attempted to examine the effects of simulations and visual modeling on students' understanding of complex processes. Schwartz (1998), for example, found that the use of modeling software improved students' conceptual models of force and motion in physics, as well as their inquiry skills and epistemological beliefs about the nature of science. In another study, Chou (1998) coupled computer simulations with a conceptual change learning environment with results that indicated improved scores on the achievement test with respect to the control (traditional lecture) courses.

Emerging from the simulations is a trend toward incorporating learning theory and higher order thinking skills into computer-based instruction. For example, Windschitl & Andre (1998) compared the effects of a constructivist versus objectivist learning environment using a computer simulation of the human cardiovascular system.

Two other studies found that combining CBI and cooperative groups enhances learning: (Luttig, 1998; and Lyon, 1998). Bos (1998) considered the availability of the Web to motivate student learning and thinking and their ability to evaluate Web sites for content. Davis's results on self-reflection suggests that designers of CBI learning environment should provide students with the opportunity to reflect upon their learning. Other studies incorporated written and oral discourse: through email and bulletin boards (Collins, 1998), computer conferencing (Robinson, 1998), and student publishing (Eriksen & Leher, 1998).

Only one study explored the potential of the Internet to provide access to online resources. Orfinger (1998) conducted a qualitative study that showed that virtual museum visits can have comparable educational value to actual science museum field trips. Of the nine Web-based studies, one study (Murrin & G. G. ) described how learning genetics from the web allowed students to collaborate with scientists and gather real data. The dearth of highly developed Web-based studies may be explained by the results encountered by Robertson (1998) who found that the number of computers connected to the Internet was too small to determine the success of an online curriculum.

Areas for future research:

- Inquiry models that use real data
- Project-based learning
- Distance learning
- Barriers to Web-based education
- Qualitative studies to examine students' communication skills
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Integrating Science With Other Subjects

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One tendency in science education is to integrate science and mathematics or mathematics, science, and other subjects (e.g., technology). These trends have influenced the elementary and secondary school curriculum. In 1998 several researchers developed theoretical models to integrate science with mathematics and/or technology education (Berlin & White, 1998; Huntley, 1998; Lonning, et al., 1998; Roebuck and Warden, 1998). For example, Huntley (1998) proposed the Mathematics/Science Continuum as an alternative theoretical framework for defining integrated mathematics and science. In addition, a continuum model of integration as a theoretical model was proposed as a tool for curriculum developers as they create new integrated mathematics and science curricula (Lonning, et al., 1998).


Even though several articles and dissertations indicated the possible positive results of an interdisciplinary approach to curriculum, some problems related to this topic can be identified based on the literature. First, as Berlin and White (1998) observe, "the literature is vague on what constitutes 'integration' as indicated by the plethora of terms used to describe it (e.g., connected, coordinated, correlated, cross-disciplinary, interrelated, multidisciplinary and unified). This vagueness indicates the absence of an agreed-upon theoretical view, which is needed to provide a language and conceptualisation of integrated science and mathematics education to direct research" (p. 500).

Second, while educational trends have promoted the development of integrated school curricula and instructional activities, many teachers still lack basic conceptions and ideas about integration. They need to participate in inservice education which models interdisciplinary lessons and uses appropriate materials and teaching methods (Adams, 1998; Alsphaugh & Harting, 1998; Hepburn & Gaskell, 1998; Lehman and McDonald, 1988; Roebuck and Warden, 1998; Watanabe & Huntley, 1998).

A past concern with integrated curricula has been that the activities developed by researchers and educators do not connect both science and other subject(s) to the real world very well, curricular materials do not stimulate student thinking, and the idea of integration has not encouraged teacher initiative. Thus, it has been argued that curricular activities should include more applications of science principles to solve real world problems, and that a range of integration characteristics should be developed in order to become more useful tools for teaching and learning science (LaPorte & Sanders, 1996; Good, 1996; Venville, et al., 1998; Wolfiner, 1994).
Overall, interdisciplinary or integration based instruction seems to provide a better chance for students to understand the connections between science and other disciplines. Integrated or interdisciplinary approaches to curriculum in science education should be a crucial area of study for the future.

Areas for future research:

- Developing school curriculum (or materials) and instructional models (or activities) with more sophisticated integrated approaches.
- Studying the effects of technology-based integration programs on students’ learning of science and other subjects.
- Providing in-service and preservice education for disseminating integration techniques and practices.
- Studying the effects of integrating science with other disciplines on students’ learning.
- Assessing teacher attitudes and knowledge in the area of integration.
- Studying contextual barriers in implementing interdisciplinary or integrated based instructions and possible solution methods.

Reference


