

DAFTAR PUSTAKA

- Abrami, P. C., Bernard, R. M., Borokhovski, E., Wade, A., Surkes., M. A., Tamin, R., & Zang, D. (2008). "Instructional Interventions Affecting Critical Thinking Skills and Disposition: A Stage 1 Meta-Analysis." *Review of Educational Research*. 78 (4), 1102-1134.
- Adnyana, P. B., Citrawati, D. M., Sumardika, I N., & Kariasa, I N., (2003). Pengembangan Model Pembelajaran Sains (Biologi) pada Pendidikan Dasar dan Menengah dengan Menerapkan Pembelajaran Berbasis Masalah untuk Mencapai Kompetensi dan Pembekalan Kecakapan Hidup (*Life Skills*). *Laporan Penelitian DIKTI*. Tidak Diterbitkan.
- Akinoğlu, O. & Tandoğan, R. Ö. (2007). "The Effects of Problem-Based Active Learning in Science Education on Students' Academic Achievement, Attitude and Concept Learning." *Eurasia Journal of Mathematics, Science & Technology Education*. 3(1), 71-81.
- Anderson, T., Howe, C., Soden, R., Halliday J., & Low, J. (2001). "Peer Interaction and the Learning of Critical Thinking Skills in Further Education Students." *Instructional Science*. 29, 1–32.
- Anwar (2004). *Pendidikan Kecakapan Hidup*. Alfabeta: Bandung.
- Arends, R. I. (2004). *Learning to Teach*. 5th Ed. Boston: McGraw Hill.
- Barak, M, Ben-Chaim, D., & Zoller, U. (2007). *Purposely Teaching for the Promotion of Higher-Order Thinking Skills: A Case of Critical Thinking*. [Online]. Tersedia: <http://www.springerlink.com/content>. [14Januari 2008]
- Barrows, H. S., (1988). *The Tutorial Process*. Springfield: Southern Illinois University School of Medicine.
- Barrows. H. S. (1996). "Problem-Based Learning in Medicine Beyond: A Brief Overview." *New Direction for Teaching and Learning*. 68, 3-12.
- Bassham, G., Irwin, W., Nardone, H., & Wallace, J. M. (2007). *Critical Thinking: A Student's Introduction*. 2nd Edition. Singapore: McGraw-Hill Company, Inc.
- Bassham, G., Irwin, W., Nardone, H., & Wallace, J. M. (2008). *Critical Thinking: A Student's Introduction*. 3rd Edition. New York: McGraw-Hill Company, Inc.

- Bers, T. (2005). "Assessing Critical Thinking in Community Colleges." *New Directions for Community Colleges*. 130, 15-25.
- Borg, W. R. & Gall, M. D. (1983). *Educational Research*. 4th Edition. New York: Longman, Inc.
- Brookfield, S. D. (1987). *Developing Critical Thinker*. Milton Stratford: Open University Press.
- Cabrera, G. A. (1992). "A Framework for Evaluating the Teaching of Critical Thinking." *Education*. 113, (1), 59-63.
- Carin, A. A. & Sund, R. B. (1989). *Teaching Science through Discovery*. Ohio: Charles E. Merrill Publishing.
- Carin, A. A. (1997). *Teaching Modern Science*. 7th Ed. New Jersey: Prentice Hall, Inc.
- Carroll, R. T., (2004). *Becoming a Critical Thinker*. [Online]. Tersedia: <http://skepdic.com/refuge/ctlessons/ch1.pdf>. [6 Juli 2007].
- Chalupa, M. & Sormunen, C. (1995). "You Make the Difference in the Classroom: Strategies for Developing Critical Thinking." *Business Education Forum*. 41-43.
- Cisneros, R. M., Salisbury-Glennon, J. D., & Anderson-Harper, H. M. (2002). "Status of Problem-Based Learning Research in Pharmacy Education: A Call for Future Research." *American Journal of Pharmaceutical Education*. 66, 19-26.
- Costa, A. L. (1985). Teaching For, Of, and About. In A. L. Costa (Eds). *Developing Minds: A Resource Book for Teaching Thinking*. Alexandria: Association for Supervision and Curriculum Development.
- Depdiknas (2006). *Permendiknas No. 22/2006: Standar Isi untuk Satuan Pendidikan Dasar dan Menengah*. Jakarta: BSNP.
- Duch, B. J., Groh, S. E., & Allen., D. E. (2001). *The Power of Problem-based Learning*. Virginia: Stylus Publishing, LLC.
- Ehlert, M. A. (2004). *An Evaluation of Problem-Based Learning: Application in an Undergraduate Supply Chain Management Course*. [Online]. Tersedia:

<http://www.iems.northwestern.edu/docs/undergraduate/honors/michelle-ehlert.pdf>. [13 Juni 2009].

Eichhorn, R. (n.d.). *Developing Thinking Skills: Critical Thinking at The Army Management Staff College*. [Online]. Tersedia: <http://www.au.af.mil/au/awc/awcgate/army/critical/roy.htm>. [14 Januari 2008].

Eklof, T. F. (2005). "Higher Mind: The Method of Critical Thinking." *Philosophical Practice*. 1(3), 129-133.

Ennis, R. E. (1987). A Taxonomy of Critical Thinking Dispositions and Abilities. In J. B. Baron & R. J. Sternberd (Eds). *Teaching Thinking Skills: Theory and Practice*. New York: W. H. Freeman and Company.

Ernst, J. & Monroe, M. (2004). "The Effects of Environment-Based Education on Students' Critical Thinking Skills and Disposition toward Critical Thinking." *Environmental Education Research*. 10(4), 507-522.

Facione, P. A., (1990). *The Delphi Report: Executive Summary*. [Online]. Tersedia: http://www.insightassessment.com/pdf_files/DEXadobe.PDF. [6 Juli 2007].

Facione, P. A., Nooren, N. C., Blohm, S. W., & Giancarlo, C. A. (2002). *The California Critical Thinking Skill Test: Test Manual 2002 Update Edition*. Milbrae CA: The California Academic Press.

Fogarty, R. (1997). *Problem-Based Learning and Multiple Intelligences Classroom*. Melbourne: Hawker Brownlow Education.

Foundation for Critical Thinking. (2004). *Pseudo Critical Thinking in the Educational Establishment: A Case Study in Educational Malpractice*. [Online]. Tersedia: <http://www.criticalthinking.org/resources/articles>. [14 Januari 2008].

Gallagher, J. J. (2007). *Teaching Science for Understanding: A Practical Guide for Middle and High School Teachers*. Ohio: Pearson Education, Inc.

Gallagher, S., Stepien, W. J., Sher, B. T. & Workman, D., (1995). "Implementing Problem-Based Learning in Science Classrooms." *School Science and Mathematics*. 95(3), 136-146.

Garratt, J., Overton, T., Tomlinson, J., & Clow, D. (2000). "Critical Thinking Exercises for Chemists." *Active Learning in Higher Education*. 1(2), 152-167.

I Wayan Redhana, 2009

Pengembangan Program Pembelajaran ...

Universitas Pendidikan Indonesia | repository.upi.edu

- Gerhard, M. (1971). *Effective Teaching Strategies with the Behavioral Outcomes Approach*. New York: Parker Publishing Company, Inc.
- Gijselaers, W. H. (1996). "Connecting Problem-Based Learning with Educational Theory." *New Direction for Teaching and Learning*. 60, 13-21.
- Halpern, D. F. (1999). "Teaching for Critical Thinking: Helping College Students Develop the Skills and Dispositions of a Critical Thinker." *New Directions for Teaching and Learning*. 80, 69-74.
- Herbert, F. & Sowell, T. (2006). *Critical Thinking: What is It Good for?* [Online]. Tersedia: <http://www.highbeam.com/library/docFree.asp?> [8 September 2006].
- Ho, B. T. (2004). Teachers as Coaches of Cognitive Processes in Problem-based Learning. In O. S. Tan (Eds). *Enhancing Thinking through Problem-based Learning Approachs: International Perspectives*. Singapore: Thomson Learning.
- Hoaglund, J. (1993). "Critical Thinking: A Socratic Model." *Argumentation*. 7(3), 291-311.
- Ikuenobe, P. (2001). "Teaching and Assessing Critical Thinking Abilities as Outcomes in an Informal Logic Course." *Teaching in Higher Education*. 6(1), 19-32.
- Inch, E. S., Warnick, B., & Endres, D. (2006). *Critical Thinking and Communication: The Use Reason in Argument*. 5th Ed. Boston: Pearson Education, Inc.
- Innabi, H. & Sheikh, O. E. (2006). "The Change in Mathematics Teachers' Perceptions of Critical Thinking after 15 Years of Educational Reform in Jordan." *Educational Studies in Mathematics*. 64, 45-68.
- Jalal, F. (2006). "Peran PPPG dalam Memfasilitasi Peningkatan Mutu Pendidik dan Tenaga Kependidikan dalam Upaya Meningkatkan Mutu Pendidikan." *Makalah Disampaikan pada Rapat Koordinasi 12 PPPG*. Jakarta.
- Jones, D. (1996). *Critical Thinking in an Online Word*. [Online]. Tersedia: <http://www.library.ucsb.edu/untangle/jones.html>. [16 Oktober 1996].

- Kelly, O. C. & Finlayson, O. E. (2007). "Providing Solutions through Problem-based Learning for the Undergraduate 1st Year Chemistry Laboratory." *Chemistry Education Research and Practice*, 2007, 8 (3), 347-361
- Kirna, I M. (1998). Penerapan Pembelajaran Konstruktivis untuk Mengurangi Miskonsepsi Mahasiswa tentang Konsep Dasar Partikel Materi, Atom, dan Molekul. *Laporan Penelitian STKIP Singaraja*. Tidak Diterbitkan
- Kolmos, A., Kuru, S., Hansen, H., Eskil, T., L., Fink, F., de Graaff, E., Wolff, J. U., & Soyly, A. (2008). *Problem-based Learning*. [Online]. Tersedia: <http://www>. [4 Februari 2008].
- Lawson, A. E. (1995). *Science Teaching and the Development of Thinking*. California: Wadsworth, Inc.
- Liliasari. (1997). Pengembangan Model Pembelajaran Materi Subyek untuk Meningkatkan Keterampilan Berpikir Konseptual Tingkat Tinggi Mahasiswa Calon Guru IPA. *Laporan Penelitian IKIP Bandung*. Tidak Diterbitkan.
- Lipman, M. (2003). *Thinking in Education*. 2nd Ed. Cambridge: Cambridge University Press.
- Lubezki, A., Dori, Y. J., and Zoller, U. (2004). "HOCS-Promoting Assessment of Students' Performance on Environment-Related Undergraduate Chemistry." *Chemistry Education Research and Practice*. 5(2), 175-184.
- Maryam, S., Redhana, I W., Istini, R. R., & Indrawati, I G. A. (2001). Peningkatan Kemampuan Guru dalam Penggunaan "Modul Bertanya" sebagai Upaya untuk Meningkatkan Penguasaan dan Aplikasi Konsep Kimia Siswa Kelas II₂ SMUN 4 Singaraja. *Laporan Penelitian DIKTI*. Tidak Diterbitkan.
- Marzano, R. J., Pickering, D., & McTghe, J. (1993). *Assessing Student Outcomes: Performance Assessment Using the Dimensions of Learning Model*. Alexandria: Association for Supervision and Curriculum Development.
- Marzano, R., Bran, R. S., Hughes, C. S., Jones., B. F., Fresseisen, B. Z., Rankin, S. C., & Suhor, C. (1988). *Dimensions of Thinking: A Framework for Curriculum and Instruction*. Alexandria: Association for Supervision and Curriculum Development.
- McGregor, D. (2007). *Developing Thinking; Developing Learning: A Guide to Thinking Skills in Education*. Berkshire: Open University Press.

- McMillan, J. H. & Schumacher, S. (2001). *Research in Education: A Conceptual Introduction*. 5th Ed. New York: Addison Wesley Longman, Inc.
- McTighe, J. & Schollenberger, J. (1991). Why Teach Thinking? A Statement of Rational. In A. L. Costa (Eds). *Developing Mind: A Resource Book for Teaching Thinking*. Alexandria: Association for Supervision and Curriculum Development.
- Meyer, C. (1986). *Teaching Students Think Critically*. London: Jossey-Bass Publishers.
- Minium, E. W., King, B., & Bear, G. (1993). *Statistical Reasoning in Psychology and Education*. 3rd Edition. Toronto: John Wiley & Sons, Inc.
- National Research Council (2000). *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning*. [Online]. Tersedia: http://books.nap.edu/html/inquiry_addendum/notice.html. [9 Oktober 2001].
- National Science Teachers Association (1998). *Standard for Science Teacher Preparation*. Association for the Education of Teachers in Science.
- Nickerson, R. S., Perkins, D. N., & Smith, E. E. (1985). *The Teaching of Thinking*. New Jersey: Lawrence Erlbaum Associates, Inc.
- Notar, C. R., Wilson, J. D., & Montgomery, M. K. (2005). *A Distance Learning Model for Teaching Higher Order Thinking*. [Online]. Tersedia: <http://findarticles.com/p/articles>. [8 September 2006].
- Ommundsen, P., (2001). *Problem-based Learning in Biology*. [Online]. Tersedia: <http://www.saltspring.com/capewest/pbl.htm>. [3 Juli 2007].
- Paraskevas, A. & Wickens, E. (2003). “Andragogy and the Socratic Method: The Adult Learner Perspective.” *Journal of Hospitality, Leisure, Sport and Tourism Education*. 2(2), 4-14.
- Paul, R. & Binker, A. J. A. (1990). *Socratic Questioning*. Rohnert Park, CA: Center for Critical Thinking and Moral Critique.
- Paul, R. & Elder, L. (2005). *A Guide for Educator to Critical Thinking Competency Standards*. [Online]. Tersedia: <http://www.criticalthinking.org>. [25 Maret 2007].

- Paul, R. (1990). *Critical Thinking: What Every Person Needs to Survive in a Rapidly Changing World*. Rohnert Park, CA: Center for Critical Thinking and Moral Critique.
- Paul, R., Binker, A. J. A., Martin, D., Vetrano, C., & Kreklau, H. (1989). *Critical Thinking Handbook: 6th-9th Grades*. Rohnert Park, CA: Center for Critical Thinking and Moral Critique.
- Penner, K. (1995). *Teaching Critical Thinking*. [Online]. Tersedia: <http://www.web.ucs.ubc.ca/kpenner/-think.htm>. [16 Oktober 1996].
- Philips, V. & Bond, C. (2004). "Undergraduates' Experiences of Critical Thinking." *Higher Education Research & Development*. 23(3), 277-294.
- Polite, V. C. & Adams, A. H. (1996). *Improving Critical Thinking Through Socratic Seminars*. [Online]. Tersedia: <http://www.temple.edu>. [8 Juli 2007].
- Ram, P., Ram, A., & Spragur, C. (2007). *From Student Learner to Professional Learner: Training for Lifelong Learning through Online PBL*. [Online]. Tersedia: <http://gatech.academia.edu/ARam/Papers/21865/From-Student-Learner-To-Professional-Learner--Training-For-Lifelong-Learning-Through-On-Line-PBL>. [13 Juni 2009]
- Redhana, I W. & Kartowasono, N., (2006). Penerapan Pembelajaran Berbasis Masalah untuk Meningkatkan Minat, Pemahaman, dan Hasil Belajar Mahasiswa Jurusan Pendidikan Matematika. *Laporan Penelitian DIKTI*. Tidak Diterbitkan.
- Redhana, I W. & Kirna, I M. (2004). Identifikasi Miskonsepsi Siswa SMA Negeri di Kota Singaraja terhadap Konsep-konsep Kimia. *Laporan Penelitian DIKTI*. Tidak Diterbitkan.
- Redhana, I W. & Maharani, L. (2008). "Pertanyaan Socratic Untuk Meningkatkan Keterampilan Berpikir Kritis Siswa." *Prosiding Seminar Nasional Kimia dan Pendidikan Kimia IV*. 9 Agustus 2008. ISBN: 978-979-184-22-0-4.
- Redhana, I W. & Simamora, M. (2007). Penerapan Pembelajaran Berbasis Masalah Berbantuan LKM untuk Meningkatkan Keterampilan pemecahan masalah Mahasiswa. *Laporan Penelitian DIKTI*. Tidak Diterbitkan.
- Redhana, I W. (2007). "Chemistry Teachers' Views towards Teaching and Learning and Assessment of Critical Thinking Skills." *Proceeding of The First*

I Wayan Redhana, 2009

Pengembangan Program Pembelajaran ...

Universitas Pendidikan Indonesia | repository.upi.edu

International on Science Education. October 27st, 2007. ISBN: 979-25-0599-7. 498-504.

Redhana, I W., Suardana, I N. & Maryam, S. (2008). Model Perubahan Konseptual pada Pembelajaran Kimia di SMA Negeri 4 Singaraja (Studi Kasus pada Pembelajaran Kimia di SMA Negeri 4 Singaraja). *Laporan Penelitian DIKTI*. Tidak Diterbitkan.

Redhana, I W., Suardana, I N., & Soma, I W. (2000). Penerapan Modul Bertanya-Diskusi-Informasi (MDI) dalam Meningkatkan Aktivitas dan Penguasaan Materi Kimia Siswa Sekolah Menengah Umum. *Laporan Penelitian DIKTI*. Tidak Diterbitkan.

Robbins, S. (2005). *The Path to Critical Thinking*. [Online]. Tersedia: <http://hbswk.hbs.edu/archive/4828.html>. [8 September 2006].

Rodrigues, S. & Bell, B. (1995). "Chemically Speaking: A Description of Student-Teacher Talk During Chemistry Lessons Using and Building on Students' Experiences." *International Journal of Science Education*. 17(6), 797-809.

Rutherford, F. J. & Ahlgren, A. (1990). *Science for All Americans*. New York: Oxford University Press.

Savery, J. R. & Duffy, T., M., (1991). "Problem-Based Learning: An Instructional Model and Its Constructivist Framework." *Constructivist Learning Environments*. 135-148.

Savinainen, A. & Scott, P. (2002). "The Force Concept Inventory: A Tool for Monitoring Student Learning." *Physics Education*. 39(1), 45-52.

Savoi, J. M. & Hughes, A. S., (1994). "Problem-Based Learning As Classroom Solution." *Educational Leadership*. Nopember. 54-57.

Schafersman, S.D. (1991). *Introduction to Critical Thinking*. [Online]. Tersedia: <http://www.freeinquiry.com/critical-thinking.html>. [25 September 2006].

Seddigi, Z. S. & Overton, T. L. (2003). "How Students Perceive Group Problem Solving: the Case of a Non-Specialist Chemistry Class." *Chemistry Education: Research and Practice*. 5(3), 387-395.

Sellnow, D. D. & Ahlfeldt, S. L. (2005). "Fostering Critical Thinking and Teamwork Skills via Problem-based Learning (PBL) Approach to Public Speaking Fundamentals." *Communication Teacher*. 19(1), 33-38.

I Wayan Redhana, 2009

Pengembangan Program Pembelajaran ...

Universitas Pendidikan Indonesia | repository.upi.edu

- Sharma, P. & Hannafin, M. (2004). "Scaffolding Critical Thinking in an Online Course: An Exploratory Study." *Journal of Computing Research*. 31(2), 181-208.
- Sidi, I. D. (2003). *Menuju Masyarakat Belajar: Menggagas Paradigma Baru Pendidikan*. Ciputat: Logos Wacana Ilmu.
- Simamora, S. & Redhana, I W. (2006). Identifikasi Miskonsepsi Guru Kimia pada Pembelajaran Konsep Struktur Atom. *Laporan Penelitian Undiksha*. Tidak Diterbitkan.
- Splitter, L. J. (1991). "Critical Thinking: What, Why, When, and How." *Educational Philosophy and Teory*. 23(1), 89-109.
- Stanford University. (2003). "The Socratic Method: What it is and How to Use it in the Classroom." *Speaking of Teaching*. 13(1), 1-4.
- Stepien, B. (2005). *Tutorial on Problem-Based Learning: Taxonomy of Socratic Questioning*. [Online]. Tersedia: <http://www-ed.fnal.gov/trc/tutorial/taxonomy.html>. [6 Juli 2007].
- Stiggins, R. J. (1994). *Student-Centered Classroom Assessment*. New York: Macmillan College Publishing Company, Inc.
- Suastra, I W., Sadia, I W., Wirta., I M., Santyasa, I W., Lidyastuti, N. M. D., Reta, N., dan Sarini, K. (1998). Pengembangan Strategi Perubahan Konseptual (*Conceptual Change*) dalam Pembelajaran IPA di Sekolah Lanjutan Tingkat Pertama. *Laporan Penelitian DIKTI*. Tidak Diterbitkan.
- Sudria, I B., Redhana, I W., Kirna, I M., Suardana, I N., & Suja, I W. (2000). Analisis Pembelajaran Konsep-Konsep Dasar Kimia di SLTP dalam Pengembangan Pembelajaran Konsep-Konsep Dasar kimia di SLTP dan Sekolah Menengah. *Laporan Penelitian IKIPN Singaraja*. Tidak Diterbitkan.
- Sund, R. B. & Trowbridge, L. W. (1973). *Teaching Science by Inquiry in The Secondary School*. 2nd Ed. Ohio: Bell & Howell Company.
- Tan, O. S. (2003). *Problem-based Learning Innovation*. Singapore: Thomson Learning.
- Tan, O. S. (2004). Cognition, Metacognition, and Problem-based Learning. In O. S. Tan (Eds). *Enhancing Thinking through Problem-based Learning Approachs: International Perspectives*. Singapore: Thomson Learning.

I Wayan Redhana, 2009

Pengembangan Program Pembelajaran ...

Universitas Pendidikan Indonesia | repository.upi.edu

- Tapper, J. (2004). "Student Perceptions of How Critical Thinking is Embedded in a Degree Program." *Higher Education Research & Development*. 23(2), 199-222.
- Thiagarajan, S., Semmel, D. S., & Semmel, M. L. (1974). *Instructional Development for Training Teacher of Exceptional Children*. Minnesota: Indiana University.
- Thomas, A. & Thorne, G. (n.d.). *Higher Order Thinking–It's HOT*. [Online]. Tersedia: <http://www.cdl.org/resource-library/articles/highorderthinking.php>. [14 Januari 2008].
- Tsapartis, G. & Zoller, U. (2003). "Evaluation of Higher vs. Lower-order Cognitive Skills-Type Examination in Chemistry: Implications for University in-class Assessment and Examination." *U.Chem.Ed.* 7, 50-57.
- United Nations Development Programme. (2005). *Human Development Report 2005*. New York: United Nations Development Programme. [Online]. Tersedia: <http://hdr.undp.org>. [25 Maret 2006].
- Utomo, T. & Ruijter, K. (1990) *Peningkatan dan Pengembangan Pendidikan*. Jakarta: Gramedia.
- Verlinden, J. (2005). *Critical Thinking and Everyday Argument*. Belmont, CA: Wadsworth/Thomson Learning, Inc.
- Walker, G. H., (1998). *Critical Thinking*. [Online]. Tersedia: <http://www.utr.edu/administration/walkerteachingresourcecenter/facultydevelopment/criticalthinking>. [6 Juli 2007].
- White, H. B. (1996). *Dan Tries Problem-Based Learning: A Case*. [Online]. Tersedia: <http://www.udel.edu/pbl/dancase3.html>. [3 Juli 2007].
- Wilson, J. & Murdoch, K. (2004). What is Inquiry Learning? [Online]. Tersedia: <http://ss.uno.edu//SS/TeachDevel/TeachMethods/InquiryMethod.html>. [4 September 2007].
- Winocur, S. L. (1985). Developing Lesson Plans with Cognitive Objectives. In A. L. Costa (Eds). *Developing Mind: A Resource Book for Teaching Thinking*. Alexandria: Association for Supervision and Curriculum Development.

- Yalcin, B. M., Karahan, T. F., Karadenisil, D., & Sahin, E. M. (2006). "Short-Term Effects of Problem-Based Learning Curriculum on Students' Self-Directed Skills Development." *Croatia Medical Journal*. 47, 491-498.
- Yang, Y. T. C., Newby, T. J., & Bill, R. L. (2005). "Using Socratic Questioning to Promote Critical Thinking Skills Through Asynchronous Discussion Forums in Distance Learning Environments." *American Journal of Distance Education*. 19(3), 163-181.
- Yuzhi, W. (2003). "Using Problem-based Learning in Teaching Analytical Chemistry." *The China Papers*. July, 28-33.
- Zohar, A. (1994). "The Effect of Biology Critical Thinking Project in The Development of Critical thinking." *Journal of Research in Science Teaching*. 31(2), 163-196.
- Zoller, U., Ben-Chaim, D., & Ron, S. (2000). "The Disposition toward Critical Thinking of High School and University Science Students: An Inter-Intra Israeli-Italian Study." *International Journal of Science Education*. 22(6), 571-582.