

REFERENCES

- Abdullah Mohd Nor. (2009). Pedagogical issues in integrating thinking skills in the classroom. *EDUCARE: International Journal for Educational Studies*, 2(1), 55-68.
- Abrams, E., Southerland, S., & Cummins, C. (2001). The how's and why's of biological change: how learners neglect physical mechanisms in their search for meaning. *International Journal of Science Education*, 23(12), 1271-1281.
- Ahmet, D. & Özden, D. (2011). Comparison of the level of using metacognitive strategies during study between high achieving and low achieving prospective teachers. *Educational Sciences: Theory & Practice*, 11 (4), 2036-2043
- Albert, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walker, P. (2002). *Molecular Biology of the Cell*. New York: Garland Publishing
- Alters, B. J., & Nelson, C. E. (2002). Teaching evolution in higher education. *Evolution*, 56, 1891-1901.
- American Association for the Advancement of Science [AAAS]. (1993). *Benchmarks for science literacy: A project 2061 report*. New York: Oxford University
- Attride-stirling, J. (2001). Thematic networks: an analytic tool for qualitative research. *Qualitative Research*, 1 (3), 385-405.
- Ausubel, D. P. (1968). *Educational psychology: a cognitive view*. New York: Holt, Rinehart & Winston.
- Baker, R. (1988). *The cell theory. A restatement, history, and critique*. New York: Garland Publishing Inc.

- Barak, J., Sheva, B., & Gorodetsky, M. (1999). As 'process' as it can get: students' understanding of biological processes. *International Journal of Science Education*, 21(12), 1281-1292.
- Barman, C., & Stein, M. (2008). Assessing basic knowledge in Biology. *The Science Teacher*, 75(3), 67-70.
- Becker, W. M., Kleinsmith, L. J., Hardin, J., & Bertoni, G. P. (2009). *The world of the cell*. United States: Pearson Education Inc.
- Best, J.B. (1999). *Cognitive Psychology*. Belmont, CA: Brooks/ Cole Wadsworth.
- Bingham, P. M. (2000). Human evolution and human history: A complete theory. *Evolutionary Anthropology*, 9 (6): 248-257
- Boaler, J. (2009). *What's Math Got to Do with It? How Parents and Teachers Can Help Children Learn to Love Their Least Favourite Subject*. Penguin: New York.
- Bolger, M. S., Kobiela, M., Weinberg, P. J., & Lehrer, R. (2012). Children's mechanistic reasoning. *Cognition & Instruction*, 30 (2), 170-206.
- Boo, H. K. (2005). Proceeding from AARE 05': *International Education Research Conference*. Australia: Queensland . Retrieved 12 September 2009, from <http://www.aare.edu.au/05pap/boo05099.pdf>
- Brewer, W. F., Chinn, C. A., & Samarapungavan, A. (1998). Explanation in scientist and children. *Minds and Machines*, 8(1), 119-136.
- Bromham, L. (2008). Teaching evolutionary biology in schools to foster active learning. *Journal of Biological Education*, 90(331), 57-63.
- Bryman, A. (2001). *Social Research Methods*. Oxford University Press, Oxford.
- Caravantes, A., & Galán, R. (2011). Generic Educational Knowledge Representation for Adaptive and Cognitive Systems. *Educational Technology & Society*, 14(3), 252-266.

- Campbell, N.A & Reece, J.B. (2005). *Biology Seventh Edition*. San Francisco: Pearson Education, Inc.
- Canal, P. (1999). Photosynthesis and 'inverse respiration' in plants: an inevitable misconception. *International Journal of Science Education*, 21(4), 363-371.
- Caravantes, A., & Galán, R. (2011). Generic educational knowledge representation for adaptive and cognitive systems. *Educational Technology & Society*, 14 (3), 252–266.
- Carey, S. (1995). On the origin of causal understanding. In D. Sperber, D. Premack & A. J. Premack (Eds.), *Causal cognition: a multidisciplinary debate*. (pp.268-308). New York: Clarendon Press
- Chapman, B. S. (2001). Emphasizing concepts and reasoning skills in introductory college molecular biology. *International Journal of Science Education*, 23(11), 1157-1176.
- Chi, M. T. H., Slotta, J. D., & Leeuw, D. (1994). From things to processes: a theory for conceptual change for learning science concepts. *Learning and Instruction*, 4, 27-43.
- Chinn, C., & Brown, D. E. (2000). Learning in science: a comparison of deep and surface approaches. *Journal of Research in Science Teaching*, 37(2), 175-218.
- Christianson, R. G., and Fisher, K. M. (1999). Comparison of student learning about diffusion and osmosis in constructivist and traditional classrooms. *International Journal of Science Education*, 21(6), 687-698
- Clough, E. E., & Wood-Robinson, C. (1985). How secondary students interpret instances of biological adaptation. *Journal of Biological Education*, 19, 125-130.
- Cohen, J (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Erlbaum
- Cohen, H.G. (1980). Dilemma of the objective paper-and-pencil assessment within the Piagetian framework. *Science Education*, 64(5), 741-745.

- Cohen, R., & Yarden, A. (2009). Experienced junior-high-school teacher PCK in light of a curriculum change: "The cell is to be studied longitudinally". *Research in Science Education, 39*, 131-155.
- Cook, M., Carter, G., & Wiebe, E. N. (2008). The influence of prior knowledge on viewing and interpreting graphics with macroscopic and molecular representation. *Science Education, 848-867*.
- Cook, M., Carter, G., & Wiebe, E. N. (2008). The interpretation of cellular transport graphics by students with low and high prior knowledge. *International Journal of Science Education, 30(2)*, 239-261.
- Cooke, T. (2008). *Todd Cooke notes on mechanistic thinking*. Retrieved from <http://umdb.org/pbworks.com/w/page/37214339/Todd%20Cooke%20notes%20on%20mechanistic%20thinking>
- Coutinho, S., Wiemer-Hastings, K., Skowronski, J. J., & Britt, M. A. (2005). Metacognition, need for cognition and use of explanations during learning and problem solving. *Learning and Individual Differences, 15*, 321-337.
- Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: a framework for memory research. *Journal of Verbal Learning and Verbal Behaviour, 11*, 671-684.
- Craver, C. F. (2001). Role function, mechanisms and hierarchy. *Philosophy of Science, 68*, 53-74.
- Craver, C. F. (2007). *Explaining the Brain: Mechanisms and the Mosaic Unity of Neuroscience*. Oxford: Oxford University Press.
- Creswell, J. W. (2008). *Educational research: Planning, conducting, and evaluating qualitative and quantitative research*. NJ: Pearson Education.
- Cummins, R. (1975). Functional Analysis. *Journal of Philosophy, 72*, 741-765.
- Daniels, H. (2001). *Vygotsky and Pedagogy*. Routledge Falmer: New York.

- Darden, L. (2002). Strategies for discovering mechanisms: schema initiation, modular subassembly, forward/backward chaining. *Philosophy of Science*, 69, S354-S365.
- Darden, L., & Craver, C. F. (2002). Strategies in the interfield discovery of the mechanism of protein synthesis. *Studies in History and Philosophy of Biological and Biomedical Sciences*, 33, 1-28.
- Davies, W. M. (2007). An 'infusion' approach to critical thinking: Moore on the critical thinking debate. *Higher Education Research & Development*, 25 (2), 179-193.
- Dawson, V., & Venville, G. J. (2009). High school students' informal reasoning and argumentation about biotechnology; an indicator of scientific literacy? *International Journal of Science Education*, 31(11), 1421-1445.
- diSessa, A. A. (1993). Towards an epistemology of physics. *Cognition and Instruction*, 10, 105-225.
- Douvdevany, O., Dreyfus, A., & Jungwirth, E. (1997). Diagnostic instruments for determining junior high-school science teachers' understanding of functional relationships within the 'living cell'. *International Journal of Science Education*, 19(5), 593-606.
- Dreyfus, A., & Jungwirth, E. (1988). The cell concept of 10th graders: curricular expectations and reality. *Journal of Biological Education*, 10(2), 221-229.
- Dreyfus, A., & Jungwirth, E. (1989). The pupil and the living cell: A taxonomy of dysfunctional ideas about an abstract idea. *Journal of Biological Education*, 23(1), 49-55.
- Driver, R., Asoko, H., Leach, J., Mortimer, E., & Scott, P. (1994). Constructing scientific knowledge in the classroom. *Educational Researcher*, 23(5-12).

- Duit, R. (2007). Science Education Research Internationally: Conceptions, Research Methods, Domains of Research. *Eurasia Journal of Mathematics, Science & Technology Education*, 3(1), 3-15.
- Duncan, R.G. (2007). The role of domain-specific knowledge in generative reasoning about complicated multileveled phenomena. *Cognition and Instruction*, 25(4), 271-336.
- Education, Audiovisual and Culture Executive Agency. (2011). *Science education in Europe: National policies, practices and research*. Retrieve from: http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/133EN.pdf
- Engeström, Y. (1994). *Training for change: new approach to instruction and learning in working life*. Geneva: International Labour Office.
- Fatima, S.K. (2007). Reasoning ability of school students. New Delhi, India: Discovery Publishing House. ISBN: 81-8356-330-9.
- Fisher, K. M. (2000). Overview of knowledge mapping. In K. M. Fisher, J. H. Wandersee, & D. E. Moody (Eds.), *Mapping biology knowledge* (pp. 5–23). Dordrecht, the Netherlands: Kluwer Academic.
- Flores, F. (2003). Representation of the cell and its processes in high school students: an integrated view. *International Journal of Science Education*, 25(2), 269 - 286.
- Fraenkel J. R. & Wallen, N. E. (2007). *How to design and evaluate research in education*. New York, America: McGraw Hill
- Freidenreich, B.H., Duncan, R. G. & Shea, N. (2011). Exploring middle school students' understanding of three conceptual models in genetics. *International Journal of Science Education*, 33(17), 2323-2349
- Ganeshadeva, M. (2011, January 30). Cultivate critical thinking and learning. *The Star*. Retrieved from www.thestar.com.my

- Gibbs, G.R.C. (2007). *Analyzing Qualitative Data*. London: SAGE Publications
- Glaser, B. G., Strauss, A.L. (1970). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine Publishing Company
- Glennan, S. (2002). Rethinking mechanistic explanation. *Philosophy of Science*, 69, S342-S353.
- Gopnik, A., Sobel, D. M., Schulz, L. E., & Glymour, C. (2001). Causal learning mechanisms in very young children: two-, three-, and four-year-olds infer causal relations from patterns of variation and covariation. *Developmental Psychology*, 37(5), 620-629.
- Greeno, J. (1992). Mathematical and scientific thinking in classrooms and other situations. In D. Halpern (Ed.). *Enhancing Thinking Skills in the Sciences and Mathematics* (pp. 39 – 61). Hillsdale, NJ: Erlbaum.
- Gross, L. (2006). Scientific illiteracy and the partisan takeover of biology. *PLoS Biology*, 4, e167.
- Guba, E. G., & Lincoln, Y. S. (1981). *Effective evaluation*. San Francisco: Jossey-Bass
- Hamizul Hamid & Merza Abbas. (2012). Collaborative scientific reasoning model for teaching geography in the Malaysian secondary schools. *Journal of Educational and Instructional Studies in The World*, 2 (3), 115-120. Retrieved from http://www.wjeis.org/FileUpload/ds217232/File/wjeis_2012.3.complete.pdf
- Hammer, D. (1995). Student inquiry in a physics class discussion. *Cognition and Instruction*, 13, 401-430.
- Harris, H. (2000). *The birth of cell*. Yale University Press.
- Hay, D. B. (2007). Using concept mapping to measure deep, surface and non-learning outcomes. *Studies in Higher Education*, 32, 39–57.
- Hay, D. B., Kinchin, I. M., & Lygo-Baker, S., (2008). Making learning visible: The role of

- Concept mapping in higher education. *Studies in Higher Education*, 33, 295–311.
- Hoagland, M.B., Zamecnik, P., & Stephenson, M.L. (1959). A hypothesis concerning the roles of particulate and soluble ribonucleic acids in protein synthesis. In R. E. Zirkle (Ed.), *A symposium on molecular biology* (pp 105-110). Chicago: Chicago University Press.
- Hoerl, C. (2011). Causal reasoning. *Philosophical Studies*, 152, 167-179.
- Hoffman, R., Klein, G. & Miller, J. (2011). Naturalistic investigations and models of reasoning about complex indeterminate causation. *Information Knowledge Systems Management*, 10, 397-425.
- Hovards, T. & Korfiatis, K. J. (2006). Word associations as a tool for assessing conceptual change in science education. *Learning and Instruction*, 16, 416 - 432.
- Howick, J., Glasziou, P., & Aronson, J. (2010). Evidence-based mechanistic reasoning. *Journal of the Royal Society of Medicine*, 103, 433-441.
- Jacob, F. (1993). *The logic of life: a history of hereditary*. Princeton, NJ: Princeton University Press.
- James, E. L., Milenkiewicz, M. T. and Bucknam, A. (2007). *Participatory Action Research for Educational Leadership: Using Data-Driven Decision Making to Improve Schools*. Thousand Oaks CA: SAGE Publications.
- Janssen, F., & de Hullu, E. (2008). A toolkit for stimulating productive thinking. *Journal of Biological Education*, 43(1), 21-26.
- Jensen, J. L. (2008). *Effects of collaboration and inquiry on reasoning and achievement in biology* (Doctoral Dissertation). Retrieved from <http://ezproxy.um.edu.my:2208/education/docview/304687259/fulltextPDF/13B5BCDB7EB6BF028E2/3?accountid=28930>

- Johnson, M. A., & Lawson, A. E. (1998). What are the relative effects of reasoning ability and prior knowledge on biology achievement in expository and inquiry classes? *Journal of Research in Science Teaching*, 35(1), 89-103.
- Jonassen, D. H. (2003). Using cognitive tools to represent problems. *Journal of Research on Technology in Education*, 35(3), 362-381.
- Jonassen, D. H., & Ionas, I. G. (2008). Designing effective supports for causal reasoning. *Educational Technology, Research and Development* 56, 287-308.
- Jonassen, D. H., & Rohrer-Murphy, L. (1999). Activity Theory as a framework for designing constructivist learning environment. *Educational Technology, Research and Development*, 47(1), 61-79.
- Jordan, R., Gray, S., Demeter, M., Liu, L., Hmelo-silver, S (2008). Adding behaviour thinking about structure and function. *The American Biology Teacher*, 70 (6): 329-330.
- Kiboss, J. K., Ndirangu, M., & Wekesa, E. W. (2004). Effectiveness of a computer-mediated simulations program in school biology on pupils' learning outcomes in cell theory. *Journal of Science Education and Technology*, 13(2), 207-213.
- Kinchin, I.M. (2011). Visualizing knowledge structures in biology: discipline, curriculum and student understanding. *Journal of Biological Education*, 45(4), 176 – 182.
- Kinchin, I. M., Hay, D. B. & Adams, A. (2000). How a qualitative approach to concept mapanalysis can be used to aid learning by illustrating patterns of conceptual development. *Educational Research*, 42, 43–57.
- Kinchin, I. M., Streatfield, D., Hay, D. B. (2010). Using concept mapping to enhance the research interview. *International Journal of Qualitative Methods*, 9(1), 52-68.
- Koslowski, B. (1996). *Theory and evidence: the development of scientific reasoning*. Cambridge, MA: MIT Press.

- Lawson, A. E. & Thompson, L. D. (1988). Formal reasoning ability and misconceptions concerning genetics and natural selection. *Journal of Research in Science Teaching*, 25 (9), 733 – 746.
- Lay, Y.F. (2009). Logical thinking abilities among Form 4 students in the interior division of Sabah, Malaysia. *Journal of Science and Mathematics in Southeast Asia*, 32(2), 161-187.
- Lazarowitz, R., & Lieb, C. (2006). Formative assessment pre-test to identify college students' prior knowledge, misconceptions and learning difficulties in biology. *International Journal of Science and Mathematical Education*, 4, 741-762.
- Lazarowitz, R., & Penso, S. (1992). High school students' difficulties in learning biology concepts. *Journal of Biological Education*, 26(3), 215-223.
- Lewis, J., & Kattmann, U. (2004). Traits, genes, particles and information, re-visiting students' understandings of genetics. *International Journal of Science Education*, 26(2), 195-206.
- Lewis, J., Leach, J., & Wood-Robinson, C. (2000a). Chromosomes: the missing link-young people's understanding of mitosis, meiosis, and fertilisation. *Journal of Biological Education*, 34(4), 189-199.
- Lewis, J., Leach, J., & Wood-Robinson, C. (2000b). What's in a cell? - young people's understanding of the genetic relationship between cells, within an individual. *Journal of Biological Education*, 34(3), 129-132.
- Lewis, J., & Wood-Robinson, C. (2000c). Genes, chromosomes, cell division and inheritance- do students see any relationship. *International Journal of Science Education*, 22(2), 177-195.

- Lin, C. Y., & Hu, R. (2003). Students' understanding of energy flow and matter cycling in the context of the food chain, photosynthesis and respiration. *International Journal of Science Education*, 25(12), 1529-1544.
- Lockhart, R. S., & Craik, F. I. M. (1990). Levels of processing: a retrospective commentary on a framework for memory research. *Canadian Journal of Psychology*, 44(1), 87-112.
- Louca, L., Elby, A., Hammer, D., & Kagey, T. (2004). Epistemological resources: applying a new epistemological framework to science instruction. *Educational Psychologist*, 39(1), 57-68.
- Machamer, P., Darden, L., & Craver, C. F. (2000). Thinking about mechanisms. *Philosophy of Science*, 67, 1-25.
- Maria Salih. (2010). Developing thinking skills in Malaysian science students via an Analogical task. *Journal of Science and Mathematics Education in Southeast Asia* . 33(1), 110-128. Retrieve from [http://www.recsam.edu.my/R&D_Journals/YEAR2010/june2010vol1/mariah\(110-128\).pdf](http://www.recsam.edu.my/R&D_Journals/YEAR2010/june2010vol1/mariah(110-128).pdf).
- McLaughlin, J. S. and Seaquist S. (2008). Using a virtual tissue culture system to assist students in understanding life at the cellular level. *The American Biology Teacher*, 70 (7): 468-473.
- Mak, S. Y., Yip, D. Y., & Chung, C. M. (1999). Alternative conceptions in biology-related topics of integrated science teachers and implications for teacher education. *Journal of Science Education and Technology*, 8(2), 161-170.
- Marbach-Ad, G., & Stavy, R. (2000). Students' cellular and molecular explanations of genetic phenomena. *Journal of Biological Education*, 34(4), 200-205.

- Marvel, S. C., & Kepler, M. V. (2009). A simple membrane osmometer system and experiments that quantitatively measure osmotic pressure. *The American Biology Teacher*, 71(6), 355-362.
- Mayr, E. (1988). *Toward a new philosophy of biology: observations of an evolutionist*. Cambridge: Belknap Press of Harvard University Press.
- Mayr, E. (1997). *This is biology: the science of the living world*. Cambridge, MA: The Belknap Press of Harvard University Press.
- Means, M. L., & Voss, J. F. (1996). Who reasons well? Two studies of informal reasoning among children of different gender, ability and knowledge levels. *Cognition and Instruction*, 14(2), 139-178.
- Melville Jones, H.E. (1999). *Infusing critical thinking in teaching educational theory*. Paper presented at the AARE-NZARE Conference, Melbourne, Australia.
- Metz, K. E. (1991). Development of explanation: Incremental and fundamental change in children's physics knowledge. *Journal of Research in Science Teaching*, 28(9), 785-797.
- McGregor, K. (2003). *"Therapy - it's a two-way thing": Women survivors of child sexual abuse describe their therapy experiences*. Unpublished doctoral thesis, Psychology Department, University of Auckland, New Zealand
- Millar, R. (1995). *Knowledge and action: Students' understanding of the procedures of scientific inquiry*. Paper presented at the First European Conference for Research in Science Education, Leeds.
- Ministry of Education [MOE]. (2005). *Curriculum specification: Biology form 4*. Putrajaya: Ministry of education.
- Ministry of Education [MOE]. (n.d.). *Education system*. Retrieve from <http://www.moe.gov.my/?id=85&lang=en>

- Ministry of Education [MOE]. (2010). *Memartabatkan Bahasa Malaysia & memperkukuhkan Bahasa Inggeris*. [To uphold Bahasa Malaysia & to strengthen the English Language]. Retrieve from <http://www.moe.gov.my/userfiles/file/MBMMBI.pdf>
- National Research Council [NCR].(1996). *National Science education Standard*. Washington, DC: National Academy
- Nor'ain Mohd Tajudin, Noorshah Saad, Nurulhuda Abd Rahman, Asmayati Yahaya, Hasimah Alimon, Mohd Uzi Dollah, Mohd Mustamam Abd Karim. (2012). Mapping the level of scientific reasoning skills to instructional methodologies among sceinces, mathematics and engineering undergraduates. *International Journal of Humanities and Social Science*, 2 (3), 147-153. Retrieve from http://www.ijhssnet.com/journals/Vol_2_No_3_February_2012/20.pdf
- Novak, J. D. (1998). *Learning, creating and using knowledge: Concept maps as facilitative tools in schools and corporations*. Hillsdale, NJ: Lawrence Erlbaum.
- Odom, A. L., & Barrow, L. H. (1995). Development and application of a two-tier diagnostic test measuring college biology students' understanding of diffusion and osmosis after a course of instruction. *Journal of Research in Science Teaching*, 32(1), 45-61.
- Odom, A. L., & Barrow, L. H. (2007). High school biology students' knowledge and certainty about diffusion and osmosis concept. *School Science and Mathematics*, 107, 94-101.
- Osborne, J. F. (1996). Beyond constructivism. *Science Education*, 80(1), 53-82.

- Ozcan, T., Yildirim, O. and Ozgur, S. (2012). Determining of the university freshmen students' misconceptions about mitosis and meiosis. *Procedia- Social and Behaviourial Sciences*, 46, 3677-3680.
- Panizzon, D. (2003). Using a cognitive structural model to provide new insights into students' understanding of diffusion. *International Journal of Science Education*, 25(12), 1427-1450.
- Pearsall, N. R. , Skipper, J. E. J., Mintzes, J. J. (1997). Knowledge restructuring in the life sciences: A longitudinal study of conceptual change in Biology. *Science Education*, 81, 193-215.
- Per äkyl ä A. (1997). Reliability and validity in research based on tapes and transcripts. In Silverman D (Ed) *Qualitative Research. Theory, Method and Practice*. Thousand Oaks CA: Sage, 201-220.
- Piaget, J. (1927). *Language and thought of the child*. Neuchatel: Delachaux et Neistle.
- Ploger, D. (1991). Reasoning and learning about mechanisms in biology. *Journal of Biological Education*, 25(1), 53-60.
- Punch, K. F. (1998). *Introduction to Social Research*. London: Sage.
- Rajendran, N.S. (2002, May). *Restructuring Teacher Education Programs to Teach Higher-Order Thinking Skills*. Paper presented at the Universiti Pendidikan Sultan Idris International Teacher Conference 2002. Kuala Lumpur, Malaysia
- Reed, S.K. (1988). *Cognition: Theory and Applications*. California: Brooks/Cole Publishing Company.
- Reed, J. H. & Kromrey, J. D. (2001). Teaching critical thinking in a community college history course: empirical evidence from infusing Paul's model. *College Student Journal*, 35 (2), 201. Retrieve from <http://www.freepatentsonline.com/article/College-Student-Journal/77399627.html>

- Riemeier, T., & Gropengießer (2008). On the roots of difficulties in learning about cell division: process-based analysis of students' conceptual development in teaching experiments. *International Journal of Science Education*, 30(7), 923-939.
- Roberts, P., Priest, H. & Traynor, M. (2006). Reliability and validity in research. *Nursing Standard*. 20, 44, 41-45.
- Russ, R., Coffey, J. E., Hammer, D., & Hutchison, P. (2009). Making classroom assessment more accountable to scientific reasoning: a case for attending to mechanistic thinking. *Science Education* 875-891.
- Russ, R., Scherr, R. E., Hammer, D., & Mikeska, J. (2008). Recognizing mechanistic reasoning in students scientific inquiry: a framework of discourse analysis developed from philosophy of science. *Science Education*, 92, 499-525.
- Sadler, T. D., & Zeidler, D. L. (2005a). Patterns of informal reasoning in the context of socioscientific decision-making *Journal of Research in Science Teaching*, 42(1), 112-138.
- Sadler, T. D., & Zeidler, D. L. (2005b). The significance of context knowledge for informal reasoning regarding socioscientific issues: applying genetics knowledge to genetic engineering. *Science Education*, 89(1), 71-93.
- Saka, A., Cerrah, L., Akdeniz, A. R., & Ayas, A. (2006). A cross-age study of the understanding of three genetic concepts: how do they image the gene, DNA and chromosomes? *Journal of Science Education and Technology*, 15(2), 192-202.
- Schauble, L. (1996). The development of scientific reasoning in knowledge-rich contexts. *Developmental Psychology*, 32(1), 102-119.

- Schnotz, W. & Kürschner, C. (2008). External and internal representations in the acquisition and use of knowledge: visualization effects on mental model construction. *Instructional Science*, 36, 175-190.
- Simons, K. D., & Klein, J. D. (2007). The impact of scaffolding and student achievement levels in a problem-based learning environment. *Instructional Science*, 35, 41-72.
- Sins, P. H. M., Savelsbergh, E. R., van Joolingen, W. R., & van Hout-Wolters, H. A. M. (2009). The relation between students' epistemological understanding of computer models and their cognitive processing on a modelling task. *International Journal of Science Education*, 9(1), 1205-1229.
- Sloman, S. A & Fernbach, P.M. (2011). Human representations and reasoning about complex causal system. *Information Knowledge System Management*, 10, 85-99.
- Songer, C., & Mintzes, J. (1994). Understanding cellular respiration: an analysis of conceptual change in college biology. *Journal of Research in Science Teaching*, 31, 621-637.
- Sopiah Abdullah & Adilah Shriff. (2008). The effects of inquiry-based computer simulation with cooperative learning on scientific thinking and conceptual understanding of gas law. *Eurasia Journal of Mathematics, Science & Technology Education*, 4 (4), 387-398. Retrieved from http://www.ijhssnet.com/journals/Vol_2_No_3_February_2012/20.pdf
- Southerland, S., Abrams, E., Cummins, C., & Anzelmo, J. (2001). Understanding students' explanation of biological phenomena: conceptual frameworks or p-prims? *Science Education*, 85(4), 328-348.
- Stamovlasis, D., & Tsaparlis, G. (2005). Cognitive variables in problem solving a nonlinear approach. *International Journal of Science and Mathematical Education*, 3, 7-32.
- Stiles, W.B. (1993). Quality control in qualitative research. *Clinical Psychology Review*, 6,

593-618.

- Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (2nd ed.). Thousand Oaks, CA: Sage.
- Sullivan, J.A. (2010). A role of representation in cognitive neuroscience. *Philosophy of Science*, 77, 875-887.
- Syed Anwar Aly & Merza Abbas. (2000, October). Penyerapan kemahiran saintifik dalam proses pengajaran dan pembelajaran kimia di tahap menengah. [Integration of Scientific skills in the teaching and learning of Chemistry at secondary level.]. Paper presented at the Mathematics and Science Education Seminar. Shah Alam, Malaysia.
- Tabery, J. G. (2004). Synthesizing activities and interactions in the concept of a mechanisms. *Philosophy of Science*, 71, 1-15.
- Taylor, A., & Jones, G. (2009). Proportional reasoning ability and concepts of scale: surface area to volume relationship in science. *International Journal of Science Education*, 31(9), 1231-1247.
- Thagard, P. (1998). Explaining disease: correlations, causes and mechanisms. *Minds and Machines*, 8, 61-78.
- Thomas, D. R. (2006). A general inductive approach for analysing qualitative evaluation data. *American Journal of Evaluation*, 27(2). 237-246
- Thomas, W. R., & MacGregor, S. K. (2005). Online project-based learning: how collaborative strategies and problem solving processes impact performance. *Journal of Interactive Learning Research*, 16(1), 83-107.
- Tessier, S. (2012). From field notes, to transcripts, to tape recordings: evolution or Combination? *International Journal of Qualitative Methods*, 11 (4), 446-460
- Torff, B. (2005). Developmental changes in teachers' beliefs about critical-thinking activities. *Journal of Educational Psychology*, 97 (1), 13-22

- Torff, B. (2006). Expert teachers' beliefs about use of critical-thinking activities with high- and low-advantage learners. *Teacher Education Quarterly*, 33 (2), 37-52.
- Van Zele, E. (2004). Improving the usefulness of concept mapping as a research tool for science education. *International Journal of Science Education*, 26(9), 1043-1064.
- Venville, G., & Donovan, J. (2007). Developing year 2 students' theory of biology with concepts of the gene and DNA. *International Journal of Science Education*, 29(9), 1111-1131.
- Verhoeff, R. P., Waarlo, A. J., & Boersma, K. T. (2008). Systems modelling and the development of coherent understanding of cell biology. *International Journal of Science Education*, 30(4), 543 - 568.
- von Aufschnaiter, C. & von Aufschnaiter, S. (2003). Theoretical framework and empirical evidence of students' cognitive processes in three dimensions of content, complexity and time. *Journal of Research in Science Teaching*, 40 (7), 616-648.
- Vygotsky, L. S. (1986). *Thought and Language* (A. Kozulin, Trans.). Cambridge, MA: MIT Press.
- Wang, J. R. (2007). Students' thinking and alternative conceptions of transport systems in plants: a follow-up study. *International Journal of Science and Mathematical Education*, 5, 307-328.
- Warburton, E. & Torff, B. (2005). The Effect of Perceived Learner Advantages on Teachers' Beliefs About Critical-Thinking Activities. *Journal of Teacher Education*, 56(1), 24-33.
- Westbrook, S. L., & Marek, E. A. (1991). A cross-age study of students understanding of the concept of diffusion. *Journal of Research in Science Teaching*, 28(8), 649-660.
- Wu, Y. T. & Tsai, C. C. (2004). The effects of different on-line searching activities on

High school students' cognitive structures and informal reasoning regarding a socio-scientific issue. *Research in Science Education*, 41 (5), 771-785.

Yu, W.F., She, H.C., & Lee, Y.M. (2010). The effects of Web-based/non-Web-based problem-solving instruction and high/low achievement on students' problem-solving ability and biology achievement. *Innovations in Education and Teaching International* , 47 (2), 187-199.

Zohar, A. & Dori, J. (2003). Higher order thinking and low-achieving students: Are they mutually exclusive? *The Journal of the Learning Sciences*, 12, 145-182.

Zohar, A., Degani, A., & Vaaknin, E. (2001). Teachers' belief about low-achieving students and high order thinking. *Teaching and Teacher Education*, 17, 469-485.

Zohar, A., & Peled, B. (2008). The effects of explicit teaching of metastrategic knowledge on low- and high- achieving students. *Learning and Instruction*, 18, 337-353.

Zohar, A., & Tamir, P. (1991). Anthropomorphism and teleology in reasoning about biological phenomena. *Science Education*, 75, 57-67.

Zuhrin Azam Ahmad. (2010, October 10). PMR to be a school-based exam. *The Star*.

Retrieved from <http://www.thestar.com.my>.