

References

- Acar Sesen, Burcin & Tarhan, Leman. (2011). Active-learning versus teacher-centered instruction for learning acids and bases. *Research in Science & Technological Education*. 29. 205-226. Retrieved from <http://dx.doi.org/10.1080/02635143.2011.581630>.
- Adesoji, F. A. (2008). Students Ability Levels and Effectiveness of Problem-Solving Instructional Strategy. *Journal of Social Physics*, 17, 5-8.
- Aimee A. Bancroft (2004) The Effects of Concept Mapping on Student Achievement in Tenth Grade Biology Students, St. Thomas Aquinas High School, Southern Louisiana.
- Ajaja, P. (2013). Which strategy best suits biology teaching? Lecturing, concept mapping, cooperative learning or learning cycle? *Electronic Journal of Science Education*. 17(1), 1-37.
- Akinoglu, O. & Tandogan, R. O. (2006). The effect of Problem Based active learning in science education on student's academic achievement, attitude and concept learning. *In Eurasia Journal of Mathematics, Science and Technology Education*, 3(1), 71-81.
- Allport, G. W. (1935). *Attitudes*. In *A Handbook of Social Psychology*. Clark University Press, Worcester, MA, 798-844.
- Anderson, William L. et al. (2005). *Comparison of student's performance in co-operative learning and traditional lecture based bio-chemistry classes*. Retrieved on April 18, 2019, <http://www.bambed.org>.
- Appoji, S. & Shailaja, H. M. (2017). Effect of concept mapping on academic achievement of students in physics in relation to gender. *International Journal of Advanced Research in Education & Technology*, 4(1), 15-17.
- Araz, G. & Sungur, S. (2007). Problem-based Learning, Effectiveness of Problem-based Learning on Academic performance in Genetics, *Biochemistry and Molecular Biology Education*, 35 (6), 448-451, 2007. Retrieved from <http://www.bambed.org>.
- Arora, M. & Kulshrestha, U. (2011). Role of Quality Management System in Improving the Quality of EIA. *Current World Environment*, 14, 205-214. Retrieved from <http://dx.doi.org/10.12944/CWE.14.2.05>.

- Asan, A. (2007). Concept Mapping in Science Class: A Case Study of Fifth Grade Students. *Journal of Educational Technology & Society*, 10(1), 186-195. Retrieved October 20, 2019 from <https://www.learntechlib.org/p/75104/>.
- Ausubel, D.P. (1968). *Educational psychology: a cognitive view*. Holt, Rinehart and Winston: New York. Retrieved from <http://www.iosrjournals.org/iosrjm/papers/Vol13-issue4/Version-1/J1304017278.pdf>.
- Awofala, A. O. A. (2011). Effect of concept mapping strategy on Students' Achievement in Junior Secondary School Mathematics. *International Journal of Mathematics trend and technology*, 3(2), 11-16.
- Barbara, (1996). Discovery lab in the chemistry lecture room: Design and evaluation of audio visual constructivist methodology of learning descriptive inorganic chemistry. Database Abstract in CD. 1966 to 2001. Retrieved from www.eric.ed.gov.
- Bentley, FJB, Kennedy, S, & Semsar, K. (2011). How not to lose your students with concept maps? *Journal of College Science Teaching*, 41, 61–68.
- Betsyl. L, Yap, Kueh C & Hoh (2011). *Students perception of Interdisciplinary, Problem-Based Learning in a Food Biotechnology Course*.
- Bharucha, N. D. (2010). *Development and Tryout of Selected Concept-map of Science at Class IX*. (Unpublished Project report), GCERT, Gandhinagar.
- Bodner, G. M. (1986). *Journal of Chemical Education*. 63(10), 873. Retrieved from <https://doi.org/10.1021/ed063p873>.
- Bogden, C. A. (1977). *The use of concept mapping as a possible strategy for instructional design and evaluation in college genetics*. Unpublished master's thesis, Cornell University, New York: Ithaca.
- Bou Jaoude & Attieh (2007). BouJaoude, S. & Attieh, M. (2008). The effect of using concept maps as study tools on achievement in chemistry. *Eurasia J. Mathematics, Science & Technology Education*, 4, 233-246. Retrieved from <https://pdfs.semanticscholar.org/4e2b/cb4c19224be916cd27042992826fe7265a1e.pdf>.
- Boyd, Mary (2013). *Introduction of Problem-based Learning in a School of Physiotherapy*. Unpublished PhD Thesis. <https://doi.org/10.25419/rcsi.10811696.v1> OR

- https://repository.rcsi.com/articles/Introduction_of_Problem-based_Learning_in_a_School_of_Physiotherapy/10811696.
- Boyle, Robert (1661). *The Sceptical Chymist*. New York: Dover Publications, Inc. (reprint). ISBN 978-0-486-42825-3.
- Brown, F.A. (2009). Collaborative Learning in the EAP Classroom: Students' Perceptions. Centre for Academic Development, Communication & Study Skills Unit, University of Botswana. Retrieved from <http://www.esp-world.info/Articles17/PDF/Collaborative%20learning.pdf>
- Bunge, Mario Augusto (1998). *Philosophy of Science: From Problem to Theory*. Transaction Publishers. p. 24. ISBN: 978-0-7658-0413-6.
- Bybee, R., & Landes, N. M. (1990). Science for life and living: An elementary school science program from Biological Sciences Improvement Study (BSCS). *The American Biology Teacher*, 52(2), 92-98.
- Çalik, M., & Ayas, A. (2005). A Cross-Age Study on the Understanding of Chemical Solutions and Their Components. *International Education Journal*. 6(1), 30-41.
- Canas, Jose & Quesada, Jose & Antoli, Adoracion & Fajardo, Inmaculada. (2003). Cognitive flexibility and adaptability to environmental changes in dynamic complex problem-solving tasks. *Ergonomics*. 46, 482-501. Retrieved from <https://doi.org/10.1080/0014013031000061640>.
- Cardemone, P. F. (1975). *Concept mapping: A technique of analyzing a discipline and its use in the curriculum and instruction in a portion of a college level mathematics skill course*. Unpublished master's thesis, Cornell University, New York: Ithaca.
- Cavallo, A. M. L. (1994). Meaningful learning, reasoning ability and students' understanding and problem solving of topics in genetics. *Journal of Research in Science Teaching*, 33, 625-656.
- Chang, K., Sung, Y. & Chen, I. (2002) The Effect of Concept Mapping to Enhance Text Comprehension and Summarization. *Journal of Experimental Education*, 71, 5-23. Retrieved from <https://doi.org/10.1080/00220970209602054>
- Chang, Raymond (1998). *Chemistry*, (6th Ed.). New York: McGraw Hill. ISBN 978-0-07-115221-1.

- Chawla, J. & Singh, G. (2015). Effect of concept mapping strategy on Achievement in Chemistry among IX grade girls. *International Journal of Informative and Futuristic Research*, 3(3), 1036-1044.
- Cheema, A., & Mirza, M. (2013). Effect of Concept Mapping on Students' Academic Achievement. *Journal of Research and Reflections in Education*, 7(2), 125-132. Retrieved from https://www.informationtamers.com/PDF/Effect_of_Concept_Mapping_On_Students%e2%80%99_Academic_Achievement.pdf
- Chen, Dai-Ling (2015) *Developing Critical Thinking through Problem-Based Learning: an Action Research for a Class of Media Literacy*. Doctoral thesis, Durham University. Retrieved from http://etheses.dur.ac.uk/11204/1/Revised_whole_thesis_dl_final_sub.pdf?DDD29+
- Childs, P.E. & Sheehan, M. (2009). What's difficult about chemistry? An Irish Perspective. *Chemistry Education Research and Practice*. 10, 204-218
- Chin, C., & Chia, L. (2006). Problem-based learning: Using ill-structured problems in biology project work. *Science Education*, 90(1), 44-67.
- Chowdhury, S. R. (2016). A Study on the Effect of Constructivist Approach on the Achievement in Mathematics of IX Standard Students. *IOSR Journal of Humanities and Social Science (IOSR-JHSS)*, 21(2), 35-40. Retrieved from <http://dx.doi.org/10.9790/0837-21223540>.
- Christopher Glaser (1663) *Affinity, Th at Elusive Dream - A Genealogy of the Chemical Revolution*. The MIT Press.
- Cole, M., & Wertsch, J. V. (1996). Beyond the individual-social antinomy in discussions of Piaget and Vygotsky. *Human Development*, 39(5), 250–256. <https://doi.org/10.1159/000278475>
- Coll, R.K., & Taylor, N. (2002). Mental Models in Chemistry: Senior Chemistry Students Mental Models of Chemical Bonding, *Chemistry Education: Research and Practice*, 3(2), 175-184.
- Conant J. B. (1951). *Science and Common Sense*. New Haven: Yale University Press.

- Demirioglu, H. & Norman, N. (1997). Effects of some variables on chemistry achievements and chemistry – related attitudes of High school students. *Journal of Education*, 16-17, 40-44.
- Derbentseva, N., Safayeni, F. & Canas, A. J., (2007). Concept maps: Experiments on dynamic thinking. *Journal of Research in Science Teaching*. 44 (3). 448–465. Retrieved from https://www.researchgate.net/publication/227626071_Concept_maps_Experiments_on_Dynamic_Thinking.
- Dumas, J. B. (1837). 'Affinite' (lecture notes), vii, pg 4. “Statique chimique”, Paris: Academie des Sciences. As cited in Smallman12q/articles/Chemistry (2018) *Chemistry*. Retrieved from <http://marcia.iqm.unicamp.br/Chemistry-Wikipedia-06-03-2011.pdf>
- Duvarcı, D. (2010). Activity-based chemistry teaching: A case of “elements and compounds”. *Procedia - Social and Behavioral Sciences*. 2. ISBN: 2506-2509. <https://doi.org/10.1016/j.sbspro.2010.03.362>.
- Ellis, A. (2001) Student-centred Collaborative Learning via Face-to-face and asynchronous online communication. FLITE Centre, Faculty of Information Technology, Monash University, Australia.
- Etuk, N. et.al. (2011). Constructivist Instructional Strategy and Pupils’ Achievement and Attitude towards Primary Science. *Bulgarian Journal of Science and Education Policy*, 5(1), 30-47. Retrieved from <http://bjsep.org/getfile.php?id=87>.
- Evelyn H. Kroesbergen & Johannes E. H. Van Luit (2005). Constructivist mathematics education for students with mild mental retardation. Article Abstract, *European Journal of Special Needs Education*, 20 (1).
- Fitzpatrick, F.C. (1960). *Policies for science Education*. New York: Bureau of Publications.
- Fosnot, C. T. (1996). Constructivism: A psychological theory of learning. In C. T. Fosnot (Ed.), *Constructivism: Theory, perspectives, and practice*, 8-33. New York: Teachers College Press.
- Gaines, Brian & Shaw, Mildred. (2000). Concept Maps as Hypermedia Components. *International Journal of Human-Computer Studies*. 43. 10.1006/ijhc.1995.1049. Retrieved from

- https://www.researchgate.net/publication/2459347_Concept_Maps_as_Hypermedia_Components.
- Gillies, R. M. (2003). The behaviors, interactions, and perceptions of junior high school students during small-group learning. *Journal of Educational Psychology*, 95(1), 137–147. <https://doi.org/10.1037/0022-0663.95.1.137>
- Glaser, Christopher (1663). *Traite de la chymie*. Paris. As found in: Kim, Mi Gyung (2003). *Affinity, That Elusive Dream – A Genealogy of the Chemical Revolution*. The MIT Press. ISBN: 978-0-262-11273-4.
- Glaserfeld (1990). Constructivist Views on the Teaching and Learning of Mathematics. *Journal for Research in Mathematics Education. Monograph*. 4, as cited Mahesha. S. J. (2014), *Effect of Social Constructivist Strategies on Achievement in Geography and Group Cohesiveness among Secondary School Students*. An Unpublished Ph. D. Thesis. Mysore: University of Mysore, India.
- Gokhale, A. A. (1995) Collaborative Learning Enhances Critical Thinking, *Journal of Technology Education*, 7(1)..
- Hardy, Michael & Taylor, Peter. (1997). Von Glaserfeld's Radical Constructivism: A Critical Review. *Science & Education*. 6. 135-150. retrieved from <https://doi.org/10.1023/A:1008664626705>.
- Haugwitz, M., Nesbit, J. C. & Sandmann, A. (2010). Cognitive ability and the instructional efficacy of collaborative concept mapping. *learning & individual differences*, 20 (5), 536.
- Herndon, Valerie (2016) *Changing places in teaching and learning: A qualitative study on the facilitation of problem-based learning* L.s, D.Ed., Capella University, 170; 10242971 retrieved from <https://pqdtopen.proquest.com/doc/1859904187.html?FMT=AI>
- Hmelo-Silver, C. E. & Barrows, H. S. (2008) Facilitating Collaborative Knowledge Building. *Cognition & Instruction*, 26, 48-94
- Hogan, K., Nastasi, B. K. & Pressley, M. (1999). Discourse patterns and collaborative scientific reasoning in peer and teacher-guided discussions. *Cognition and Instruction*, 17, 379-432.

- Huddle, P. A., & White, M. D. (2000). Using a Teaching Model to Correct Known Misconceptions in Electrochemistry. *Journal of Chemical Education*. 77(1), 104 - 110.
- Johnson, D. J. (1991). Active learning: Cooperation in the college classroom. Edina: Interaction Book Company.
- Johnson, D. W. & Johnson, R. (1999). Learning together and alone: *Cooperative, competitive, and individualistic learning* (5th Ed.). Boston: Allyn & Bacon.
- Johnson, D. W. & Johnson, R. T. (1989). Cooperation and competition: Theory and research. Edina, MN: Interaction Book Company
- Johnson, D. W., & Johnson, R. (1999). Learning together and alone: Cooperative, competitive, and individualistic learning (5th Ed.). Boston: Allyn & Bacon.
- Johnson, D. W., Johnson, R., & Holubec, E. (2013). Cooperation in the classroom (9th ed.). Edina, MN: Interaction Book Company.
- Johnson, D.W. (2009). "An Educational Psychology Success Story: Social Interdependence Theory and Cooperative Learning". *Educational Researcher*. 38 (5), 365-379. <https://doi.org/10.3102/0013189x0933905>.
- Johnson, D.W., & Johnson, F. (2009). Joining together: *Group theory and group skills* (10th ed.). Boston: Allyn & Bacon.
- Johnstone, A. H. (2006). Chemical Education Research in Glasgow in Perspective. *Chemistry Education Research and Practice*. 7(2), 49-63.
- Jong Sukkin (2005), The Effects of a Constructivist Teaching Approach on Students Academic Achievement, Self-Concept and Learning Strategies. *Asia Pacific Educational Services*, 6 (1).
- Jusniar, J., Effendy, E., Budiasih, E. & Sutrisno, S. (2020). Misconceptions in Rate of Reaction and their Impact on Misconceptions in Chemical Equilibrium. *European Journal of Educational Research*, 9 (4), 1405 – 1423. ISSN: 2165-8714.
- Kaul, Palalvi. (2010). The Effect of Learning Together Techniques of Cooperative Learning Method on Students Achievement in Mathematics. *Edutracks*, 9(12), 28.
- Khirwadkar, A. (2007). *Teaching of chemistry*. New Delhi: Sarup and sons.
- Kirschner, F.C., Paas, F., Kirschner, P.A., & Janssen, J. (2011). Differential effects of problem solving demands on individual and collaborative learning outcomes. *Learning*

- and Instruction, 21, 587-599 retrieved from <http://dx.doi.org/10.1016/j.learninstruc.2011.01.001>.
- Koffka, K. (2014). *Principles of Gestalt psychology*. Mimesis International. ISBN: 9788857523934.
- Kolomuç, A., & Tekin, S. (2011). Chemistry teachers' misconceptions concerning the concept of chemical reaction rate. *Eurasian Journal of Physics and Chemistry Education*, 3(2), 84-101.
- Kroesbergen, Evelyn H. & Van Luit, Johannes E. H. (2005), "Constructivist mathematics education for students with mild mental retardation" Article Abstract, *European Journal of Special Needs Education*, 20(1), Netherland.
- Laal, M. (2015) Positive Interdependence in Collaborative Learning. 3rd World Conference on Learning, Teaching and Educational Leadership (WCLTA-2012), *Procedia-Social and Behavioral Sciences*, 93 (2013), 1433-1437. Retrieved on March 22, 2016 from: www.researchgate.net/publication/259081489_Positive_Interdependence_in_Collaborative_Learning.
- Laal, M., Naseri.A.S., Laal, M. & Kermanshahic, Z.K., (2013). What do we achieve from learning in collaboration? 3rd World Conference on Learning, Teaching and Educational Leadership (WCLTA-2012).
- Lederman, S. J. (1983). Tactual roughness perception: Spatial and temporal determinants. *Canadian Journal of Psychology*, 37, 498–511.
- Madu, B. & Ezeamagu, M. (2013). Effect of constructivist based approach (5Es) on the pupils' achievement in primary mathematics in enugu state, Nigeria. Article abstract, *International Journal of Educational Science and Research (IJESR)*. 3 (4).
- Mahesha. S. J. (2014), *Effect of Social Constructivist Strategies on Achievement in Geography and Group Cohesiveness among Secondary School Students*. An Unpublished Ph. D. Thesis. Mysore: University of Mysore, India.
- Malhotra, V. (2006). *Methods of Teaching Physics*. New Delhi: Crescent Publishing Corporation.
- Mani, R. S. (2015). Objectives of Teaching Chemistry in Modern Schools. *International Journal of scientific research*, 5(1), 406- 409.

- Martin Dougiamas (1998). *A journey into Constructivism*. Retrieved on June 12, 2017 from <https://dougiamas.com/archives/a-journey-into-constructivism/>.
- Martin, David A. (2017) *The impact of problem-based learning on pre-service teachers' development and application of their mathematics pedagogical content knowledge*. Retrieved from <http://eprints.usq.edu.au/id/eprint/32851>. DOI:10.26192/5bf788ddf93e4.
- Mehra, V. (2008). Effectiveness of Co-operative Learning on Achievement and Retention in Mathematics of Seventh Graders with Different Cognitive Styles. *Indian Educational Review*, 44 (1), 5-31.
- Mehta, S. & Kulshresth, A. K. (2012). *Development of Co-operative Learning Based Instructional Material in Science for Secondary Level*, Unpublished M.Ed. Dissertation, Dayalbagh Educational Institute, India.
- Merill, A. S. (2009). The Impact of Constructivist Teaching Strategies on the Acquisition of Higher Order Cognition and Learning, *Dissertation Abstract International*, 70(2), 499.
- Nakiboglu, C. (2003). Instructional misconceptions of Turkish prospective chemistry teachers about atomic orbitals and hybridization. *Journal of Chemistry Education Research and Practice*. 4(2) 171-188.
- NCF (2005). *National curriculum Framework, National Council for Educational Research and Training*, New Delhi: NCERT.
- Newman, Mark John (2003) *Problem based learning for continuing professional education: an exploration of the method and its effectiveness*. Unpublished PhD thesis, Middlesex University. Retrieved from <https://eprints.mdx.ac.uk/6711/1/Newman.phd.pdf> or <https://eprints.mdx.ac.uk/id/eprint/6711>.
- Novak, J. D., & D. B. Gowin. (1984). *Learning How to Learn*. New York and Cambridge, UK: Cambridge University Press.
- NRICH Primary Team & Jenny Earl (2016). *The Problem-solving Classroom*. Cambridge: University of Cambridge. Retrieved from <https://nrich.maths.org/12779>
- Olarewaju, A., & Awofala, A. (2011). Effect of Concept Mapping Strategy on Students' Achievement in Junior Secondary School. *Journal of Mathematical Trends and Technology*, 2, 11-16.

- Oliver, J. & Paul, M. (2018). *Applied Bioinformatics-An Introduction*. eBook. ISBN: 9783319683010. Retrieved from <https://www.dbooks.org/applied-bioinformatics-3319683012/>
- Oliver, J. & Paul, M. (2018). *What has chemistry ever done for you?* Australian academy of science. Retrieved on November 15, 2019 from <https://www.science.org.au/curious/chemistry>.
- Oludipe Bimbola, & Oludipe I. Daniel (2010). *Effect of constructivist-based teaching strategy on academic performance of students in integrated science at the junior secondary school level*, Article abstract, Journal of Science Education and Technology, Ogun State, Nigeria.
- Orgil, M., & Sutherland, A. (2008). Undergraduate Chemistry Students' Perceptions of and Misconceptions about Buffers and Buffer Problems. *Chemistry Education Research Practice*. 9, 131-143.
- Orgill, Marykay & Sutherland, Aynsley. (2008). Undergraduate chemistry students' perceptions of and misconceptions about buffers and buffer problems. *Chemistry Education Research and Practice - CHEM EDUC RES PRACT*. 9. <https://doi.org/10.1039/b806229n>.
- Ozmen, H. (2008). Determination of students' alternative conceptions about chemical equilibrium: A review of research and the case of Turkey. *Chemistry Education Research and Practice*, 9(3), 225–233. <https://doi.org/10.1039/B812411F>
- Pachaurya, A. C. (2008). Constructionist Approach in Teaching and Learning Science. New Delhi: NCERT. *Journal of School Science*, 46(4).
- Pandey (2019). Effectiveness of Concept Attainment and Concept Mapping Teaching Strategies for teaching Biology to class IX students. Unpublished Ph.D. Thesis, Prayagraj: University of Allahabad.
- Pauling, Linus (1947). General Chemistry. Dover Publications, Inc. ISBN: 9780486656229.
- Piaget, J. (1932). The moral development of the child. London: Routledge & Kegan Paul.
- Piaget, J. (1951). *The psychology of intelligence*. London, UK: Routledge & Kegan Paul.
- Piaget, J. (1964). Development and Learning. *Journal of Research in Science Teaching*, 2, 176-186.

- Piaget, J. (1985). The equilibration of cognitive structures. Chicago: University of Chicago Press.
- Pinarbasi, T., Sozbilir, M., & Canpolat, N. (2009). Prospective Chemistry Teachers' Misconceptions about Colligative Properties: Boiling Point Elevation and Freezing Point Depression. *Chemistry Education Research and Practice*. 10, 273–280.
- Ponnusamy.P. & Sudarsan.S, (2005). Student achievement and Cooperative Learning method in Mathematics at upper primary level school science.” *Indian Educational Abstracts*, 5 (1), 36.
- Popper, Karl R. (2002) (1959). A survey of some fundamental problems: *The Logic of Scientific Discovery*. New York: Routledge Classics. 3-26. ISBN: 9780415278447, OCLC 59377149
- PrakashSatya C. V. & Patnaik, S.P., (2006). Effect of Co-operative Learning on Achievement Motivation and Achievement in Biology. *Indian Educational Abstracts*, 6(1), 11.
- Rae (2008). As cited in Mahesha (2014) Mahesha. S. J. (2014), *Effect of Social Constructivist Strategies on Achievement in Geography and Group Cohesiveness among Secondary School Students*. An Unpublished Ph. D. Thesis. Mysore: University of Mysore, India.
- Rao, M. P. (2003). Effect of Concept Mapping in Science on Science Achievement, Cognitive Skills & Attitude of Students, *ERIC Project*, NCERT, New Delhi.
- Ratcliffe, M. (2002). ‘What’s difficult about A-level chemistry?’ *Education in Chemistry*. 39(3), 76- 80.
- Ravula, K. (2013). *Constructivism and Its Approach of Teaching Social Science at Secondary Level – A Critical Survey In Telangana Region*. An Unpublished Ph.D. Thesis, Hyderabad: Osmania University.
- Revathi. D (2015). *Effect of Collaborative Learning on Learning Outcomes of Students with Special Needs in Inclusive School*. Unpublished Ph.D. Thesis, Avinashilingam University for Women, Coimbatore.
- Richard, C. K. et al. (2015). Effects of Constructivist Teaching Approach on Students' Achievement in Secondary School Chemistry in Baringo North Sub-County, Kenya, *International Journal of Advanced Research*, 3(7), 1037-1049. Retrieved from http://www.journalijar.com/uploads/42_IJAR-6534.pdf.

- Robyn McRae Lonergan (2017). *Problem-Based Learning: Does it have a place in diverse middle-school science classrooms?* Unpublished PhD Thesis. The University of New South Wales, Retrieved on April 22, 2018 from <http://unsworks.unsw.edu.au/fapi/datastream/unsworks:52146/SOURCE02?view=true>.
- Rosen, Y. & Rimor, R. (2009) Using a Collaborative Database to Enhance Students' knowledge construction, *Interdisciplinary Journal of ELearning and Learning Objects*, 5.
- Russell, J. B. (1980). *General Chemistry*, McGraw-Hill International Book Company. Retrieved from http://chemweb.ucc.ie/what_is_chemistry.htm.
- Salomon & Perkins (1998). Review of research in education. (Edt.) New Delhi: Sage Publication.
- SatyaPrakash, C.V. & Patnaik, S.P., (2006). Effect of Co-operative Learning on Achievement Motivation and Achievement in Biology. *Indian Educational Abstracts*, 6(1), 11.
- Seed Magazine (2007) Scientific Method: Relationships Among Scientific Paradigms. Seed Magazine, March 7, 2007. Archived from the original on November 1, 2016. Retrieved on November 4, 2016 from https://www.seedmagazine.com/content/article/scientific_method_relationships_among_scientific_paradigms/
- Sendur, G., Toprak, M., & Pekmez, E.S. (2011) How can secondary school perceive chemical equilibrium. *New World Science Academic*, 6(2), 1512-1531.
- Senocak, E. (2005). *A Study on the Effects of Problem Based Learning Approach on Teaching the Gases*. Unpublished PhD thesis, Ataturk University, Erzurum.
- Sharma, L. Harsana, G. & Sharma, K. (2013) Laxmi Sharma, Geeta Harsana, Komal Sharma - Study of Effectiveness of Using Concept Maps in Science among VI Grade Students. *International Journal of Scientific and Research Publications*, 3 (4). Retrieved from <http://www.ijsrp.org/research-paper-0413.php?rp=P161073>.
- Sharma, S. V. (2012). A Study of the Impact of Constructivist Approach on Students' Understanding the Concepts of Work, Energy and Power at Senior Secondary Level. *International Journal of Science and Research*.
- Shukor, N. A., Tasir, Z., Van der Meijden, H., & Harun, J. (2014). Exploring Students' Knowledge Construction Strategies in Computer-Supported Collaborative Learning

- Discussions Using Sequential Analysis. *Educational Technology & Society*, 17 (4), 216-228.
- Siddiqui, U. (2016). Effectiveness of 5E Learning Cycle Model of Constructivist Approach on Ninth–Grade Students’ Understanding of Colloids, *Peripex Indian Journal of Research*, 5(3). <https://doi.org/10.15373/22501991/March2016/40>.
- Singh I. S. & Moono K. (2015). The effect of using concept maps on student achievement in selected topics in chemistry at tertiary level. *Journal of education and practice*, 6 (15), 106-116
- Sirhan, G. (2007). Learning difficulties in chemistry: An overview. *Journal of Turkish Science Education*, 4(2), 2-20.
- Siva Krishnan (2009) *Student Experiences of Problem-Based Learning in Engineering: Learning Cultures of PBL Teams*.http://vuir.vu.edu.au/15196/1/Siva_Thesis.pdf
- Snead, D. & Young, B. (2003). Making connection with Concept Mapping: A Tool for Under-Achieving Middle Grade Science Student. *Tennessee Educational Leadership*, pp. 25-30. Retrieved from <https://files.eric.ed.gov/fulltext/ED563980.pdf>
- Sola, A. O. & Ojo, O. E. (2007). Effects of Project, Inquiry and Lecture-Demonstration Teaching Methods on Senior Secondary Students’ Achievement in Separation of Mixtures Practical Test. *Educational Research and Review*, 2(6), 124-132. Retrieved from <http://www.academicjournals.org/err>.
- Sood, J. K. (2008). Learning science as a constructivist conceptual change process. *School science*, 45, 3-12.
- Sow, K L. (2006). *The Effects of Constructivist-Strategies and Direct Instruction Using Multimedia on Achievement Among Learners with Different Psychological Profiles*. Retrieved from http://eprints.usm.my/9861/1/the_effects_of.pdf.
- Sreelekha, S. & Nayar, A. K. (2008). The Effectiveness of Concept Attainment Model (CAM) in Learning Chemistry at Secondary Level, Research Paper, *NCERT*, New Delhi.
- Sridevi, K.V. (2012), *Effectiveness of Constructivist approach on Students' Achievement in Science and Scientific Attitude and perception of nature of science at Secondary level*. Thesis abstract, Mysore: University of Mysore, India.

- Sridevi, K.V. (2013). Effects of Constructivist approach on students' perception of nature of Science at secondary level, *Artha J Soc Sci*, 12, 1(2013), 49-66 ISSN: 0975-329x. Retrieved from <https://doi.org/10.12724/ajss.24.4,49>.
- Srinivas, H. (2017). Collaborative Learning: Four Collaborative Learning Strategies. Retrieved from <https://www.gdrc.org/kmgmt/c-learn/strategies.html>.
- Stahl, George, E. (1730). *Philosophical Principles of Universal Chemistry*. London.
- Stuart, H. A. (1985) Should concept maps be scored numerically? *European Journal of Science Education*, 7, 73-81.
- Sulaiman, F. (2011). The effectiveness of Problem-Based Learning (PBL) online on students' creative and critical thinking in physics at tertiary level in Malaysia (Thesis, Doctor of Philosophy (PhD)). University of Waikato, Hamilton, New Zealand. Retrieved from <https://hdl.handle.net/10289/4963or> <https://researchcommons.waikato.ac.nz/handle/10289/4963>.
- Sunal & Hass, 2002 Sunal, C.S., & Haas, M.E. (2008). Social studies for the elementary and middle grades: A constructivist approach (3rd ed.). Boston, MA: Pearson.
- Sungur, S., & Tekkaya, C. (2006). Effects of problem-based learning and traditional instruction on self-regulated learning. *Journal of Educational Research*, 99(5), 307-317. Retrieved September 21, 2016, from <https://EBSCOhost>.
- Tandel, S. (2012). *Development of Meta cognitive Skills in Science Student-Teachers through Constructivist Approach*. An Unpublished Ph. D. Thesis. Vadodara: The Maharaja Sayajirao University of Baroda.
- Tang, A.Y.C., Zain, S. M., & Abdullah, R. (2010). Development and evaluation of chemistry educational software for learning organic reactions using qualitative reasoning. *International Journal of Education and Information technologies*, 3 (4), 129- 138.
- Tarhan, L., Ayar-Kayali, H., Ozturk-Urek, R., & Acar B. (2008). Problem-based learning in 9th grade chemistry class: Intermolecular forces. *Research in Science Education*, 38(3), 285-300.
- Taylor, P. (1996) Mythmaking and mythbreaking in the mathematics classroom, *Educational Studies in Mathematics*. 31, 151-173

- Taylor, P. (1998) *Constructivism: Value added*, In: B. Fraser & K. Tobin (Eds), The International handbook of science education, Dordrecht, The Netherlands: Kluwer Academic.
- Terenzini, P.T., Cabrera, A.F., Colbeck, C. L., Parente, J.M., & Bjorklund, S.A (2013) Collaborative Learning vs. Lecture/Discussion: Students' Reported Learning Gains. *Journal of Engineering Education*, 90(1), 123-130.
- Thankarajathi, S. (2007). Co-operative learning approach in learning Mathematics. *Journal of Educational Research and extension*, 44 (2).
- Thomas B. I. et al. (2014). Effect of a Constructivist Instructional Strategy on Affective Outcomes by Integrated Science Students. *International Review of Contemporary Learning Research*, 3(1).
- Toraman, C. & Demir, E. (2016). The Effect of Constructivism on Attitudes towards Lessons: A Meta-Analysis Study. *Eurasian Journal of Educational Research*, 62, Retrieved on May 26, 2018 from <https://dx.doi.org/10.14689/Ejer.2016.62.8>.
- Trochim, W. (2004). Concept mapping. In S. Matheson (Ed.), *Encyclopedia of evaluation*. Thousand Oaks, CA: Sage.
- Tudge, J. R. H. (1992). Processes and consequences of peer collaboration: A Vygotskian analysis. *Child Development*, 63(6), 1364-1379.
- Umashree, P.S. (1999). Science Curriculum and its Transaction: An Exploratory Study in Secondary Schools of Vadodara, Gujarat. An Unpublished Ph.D. Thesis, The Maharaja Sayajirao University of Baroda, Vadodara.
- University of Michigan. (2018). *A Role of Chemistry in Society B. Chemistry and the Environment*. Retrieved on May 26, 2018 from www.umich.edu or https://www.google.com/url?sa=t&source=web&rct=j&url=http://www.umich.edu/~nppcpub/resources/compedia/CHEMpdfs/CHEMII.pdf&ved=2ahUKEwia-L3ar_HoAhXG7HMBHRpxAEcQFjAAegQIBxAB&usg=AOvVaw0LIn0udlOYBi889khjXTQf
- Van Boxtel, C. A. M., Van der Linden, J., & Kanselaar, G. (2000). Collaborative learning tasks and the elaboration of conceptual knowledge. *Learning and Instruction*, 10, 311-330. [http://dx.doi.org/10.1016/S0959-4752\(00\)00002-5](http://dx.doi.org/10.1016/S0959-4752(00)00002-5).

- Vickneasvari, A. & Krishnasamy, P. (2007). *Chemical formulae and Equations*. Thesis abstract, University Sains, Malaysia.
- Vygotsky, L. S. (1983). Thinking and speech. Belgrade, Nolit.
- Vygotsky, L. S. (1988). Historic development of human behaviour. In: J. Miric (Ed.) Cognitive development of a child. Belgrade, SDPS.
- Wendt, J.L. (2013). The Effects of online collaborative learning on middle school students' science literacy and sense of community. Unpublished PhD thesis, Liberty University, .
- Wertsch, J. (1991), *Voices of the mind: A sociocultural approach to mediate action*. Cambridge (MA): Harvard University Press.
- Wertsch, J. V. (1985). *Vygotsky and social formation of mind*. Cambridge (MA): Harvard University Press.
- William L. Anderson. et al. (2005). *Comparison of student's performance in co-operative learning and traditional lecture-based bio-chemistry classes*. Retrieved on April 18, 2019, <http://www.bambd.org>.
- Wilson, E.O. (1999). The natural sciences. *Consilience: The Unity of Knowledge* (Reprint ed.). New York, New York: Vintage, 49–71. ISBN 978-0-679-76867-8.
- Windschitl, M. (2002). Framing Constructivism in Practice as the Negotiation of Dilemmas: An Analysis of the Conceptual, Pedagogical, Cultural, and Political Challenges Facing Teachers. *Review of Educational Research*, 72 (2), 131–175.
- Yau, S.S., Gupta, S. K. S., Karim, F. et al (2003). Smart Classroom: Enhancing Collaborative Learning Using Pervasive Computing Technology. Engineering, 1-9.
- Zuway- R. Hong (2010) Effects of a Collaborative Science Intervention on High Achieving Students' Learning Anxiety and Attitudes toward Science, *International Journal of Science Education*, 32(15), 1971 1988, DOI: 10.1080/09500690903229304.

Important Web link:

<https://www.sciencedirect.com/science/article/pii/S1877042811030217>