CE> Vol.2 No.5, December 2011

OPEN ACCESS

External Representations in the Teaching and Learning of Introductory Chemistry

PDF (Size:930KB) PP. 461-465 DOI: 10.4236/ce.2011.25067

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ABSTRACT

This manuscript describes the role that external representations, such as diagrams and sketches, can play in organizing and learning concepts presented in a one-semester chemistry course (general, organic and biochemistry) designed for nursing students. Although external representations are typically found in chemistry textbooks and instructor-drawn notes, students are usually not taught or prompted to use various types of external representations to promote learning. Representations created by an instructor and a student are discussed to highlight effective ways to foster student participation in creating various diagrams. In addition, a student provides a perspective on the educational value of creating external representations and the roles of visual thinking and creativity in learning introductory chemistry. Although the model for this approach has been an introductory chemistry course, this approach can be widely applied across disciplines.

KEYWORDS

Visual Thinking, External Diagrams, Active Learning

Cite this paper

Cox, J. & Jones, B. (2011). External Representations in the Teaching and Learning of Introductory Chemistry. *Creative Education, 2,* 461-465. doi: 10.4236/ce.2011.25067.

References

[1] Coil, D., Wenderoth, M. P., Cunningham, M., & Dirks, C. (2010). Teaching the process of science: faculty perceptions and an effective methodology. CBE-Life Sciences Education, 9, 524-535. doi:10.1187/cbe.10-01-0005

[2] Cooper, M. M., & Sandi-Urena, S. (2009). Design and validation of an instrument to assess metacognitive skillfulness in chemistry problem solving. Journal of Chemical Education, 86, 240-245. doi:10.1021/ed086p240

[3] Derting, T. D., & Cox, J. R. (2008). Using a tablet PC to enhance student engagement and learning in an introductory organic chemistry course. Journal of Chemical Education, 85, 1638-1643. doi:10.1021/ed085p1638

[4] Derting, T. L., & Ebert-May, D. (2010). Learner-centered inquiry in undergraduate biology: Positive relationships with long-term student achievement. CBE—Life Sciences Education, 9, 462-472. doi:10.1187/cbe.10-02-0011

[5] Deslauriers, L., Schelew, E., & Wieman, C. (2011). Improved learning in a large-enrollment physics class. Science, 332, 862-864. doi:10.1126/science.1201783

[6] Gilbert, J. K. (2005). Visualization: A metacognitive skill in science and sience education. In J. K. Gilbert (Ed.), Visualization in Science Education (Vol. 1, pp. 9-27). Dordrecht: Springer. doi:10.1007/1-4020-3613-2_2

[7] Gobert, J. D., & Clement, J. J. (1999). Effects of student-generated diagrams versus student-generated summaries on conceptual understanding of casual and dynamic knowledge in plate

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tectonics. Journal of Research in Science Teaching, 36, 39-53. doi:10.1002/(SICI)1098-2736(199901)36:1<39::AID-TEA4>3.0.CO;2-I

[8] Haak, D., HilleRisLambers, J., Pitre, E., & Freeman, S. (2011). Increased structure and active learning reduce the achievement gap in introductory biology. Science, 332, 1213-1216. doi:10.1126/science.1204820

[9] Hall, V. C., Bailey, J., & Tillman, C. (1997). Can student-generated illustrations be worth ten thousand words? Journal of Educational Psychology, 89, 677-681. doi:10.1037/0022-0663.89.4.677

[10] Larkin, J. H., & Simon, H. A. (1987). Why a diagram is (sometimes) worth ten thousand words. Cognitive Science, 11, 65-99. doi:10.1111/j.1551-6708.1987.tb00863.x

[11] Lee, W. T., & Jabot, M. E. (2011). Incorporating active learning techniques into a genetics class. Journal of College Science Teaching, 40, 94-100.

[12] Mathewson, J. H. (1999). Visual-spatial thinking: An aspect of science overlooked by educators. Science Education, 83, 33-54. doi:10.1002/(SICI)1098-237X(199901)83:1<33::AID-SCE2>3.0.CO;2-Z

[13] Mayer, R. E., & Gallini, J. K. (1990). When is an illustration worth ten thousand words? Journal of Educational Psychology, 82, 715-726. doi:10.1037/0022-0663.82.4.715

[14] Mazur, E. (2009). Farewell, lecture? Science, 323, 50-51.

[15] doi:10.1126/science.1168927

[16] Milne, A. J. (2007). Entering the interaction age today: implementing a future vision for campus learning spaces. Educause Review, 42, 13-31.

[17] National Research Council (2000). How people learn: Brain, mind, experience, and school. In Committee on Developments in the Science of Learning, John D. Bransford, Ann L. Brown, and Rodney R. Cocking (Eds.) with additional material from the Committee on Learning Research and Educational Practice, M. Suzanne Donovan, John D. Bransford, and James W. Pellegrino (Eds.), Commission on behavioral and social sciences and education, National Research Council. Washington, DC: The National Academy Press.

[18] Pink, D. H. (2005). A whole new mind: Moving from the information age to the conceptual age. New York: Riverhead.

[19] Ramadas, J. (2009). Visual and spatial modes in science learning. International Journal of Science Education, 31, 301-318. doi:10.1080/09500690802595763

[20] Rickey, D., & Stacy, A. M. (2000). The role of metacognition in learning chemistry. Journal of Chemical Education, 77, 915-920. doi:10.1021/ed077p915

[21] Roam, D. (2008). The back of the napkin: Solving problems and selling ideas with pictures. New York: Penguin.

[22] Sch?nborn, K. J., & Anderson, T. R. (2006). The importance of visual literacy in the education of biochemists. Biochemistry and Molecular Biology Education, 34, 94-102. doi:10.1002/bmb.2006.49403402094

[23] Stranger-Hall, K. F., Shockley, F. W., & Wilson, R. E. (2011). Teaching students how to study: A workshop on information processing and self-testing helps students learn. CBE-Life Sciences Education, 10, 187-198. doi:10.1187/cbe.10-11-0142

[24] Suwa, M., & Tversky, B. (2002). External representations contribute to the dynamic construction of ideas. Diagrammatic Representation and Inference, 2317, 149-160. doi:10.1007/3-540-46037-3_33

[25] Tsai, C.-C. (2001). A review and discussion of epistemological commitments, metacognition, and critical thinking with suggestions on their enhancements in internet-assisted classrooms. Journal of Chemical Education, 78, 970-974. doi:10.1021/ed078p970

[26] Tversky, B. (2002). What do sketches say about thinking? AAAI Spring Symposium on Sketch Understanding, Menlo Park, CA.

[27] Weimer, M. E. (2002). Learner-centered teaching. Five key changes to practice. San Francisco, CA: Jossey-Bass.