THE EDUCATION UNIVERSITY OF HONG KONG

Course Outline

Part I

Programme Title : Doctor of Education (Science Education)
Course Title : Theories and practices of science learning
Course Code : SCG7011
Department : Science and Environmental Studies
Credit Points : 3
Contact Hours : 5 hrs (contact hours) and 34 hrs (directed study)
Pre-requisite(s) : Nil
Medium of Instruction : English

Part II

1. Synopsis

This module critically examines contemporary research findings on a variety of theories of science learning and its implications for practice. It considers the nature of science education and the logic and reasoning involved in it. The relevance of constructivism to science learning including conceptual change, and the application of inquiry in the science classroom are discussed together with other perspectives including social constructivist and social cultural perspectives to develop insights into more effective learning strategies. Research into children's alternative frameworks, scientific reasoning, teacher-student interactions, and affective factors are drawn upon to substantiate a multi-perspective epistemological framework. Discussion within the module is centred on how theories and practices can be bridged in the local school context with regard to teaching and assessment approaches, and the challenges faced by teachers in the recent science curriculum reform.

2. Course Intended Learning Outcomes ($CILO_s$)

Upon successful completion of this course, students will be able to:

$CILO_1$ demonstrate an indepth understanding of the nature of science education;
$CILO_2$ critically evaluate research on different perspectives on learning of science;
$CILO_3$ critically review the various strategies of assessment of science learning and their implications for curriculum design and classroom learning.

3. Content, CILOs and Teaching & Learning Activities

Course Content	CILOs	Suggested Teaching & Learning Activities

Nature of science education - Revisiting scientific literacy in the context of recent curriculum reforms and its implications for the teaching and learning of science - Learning the nature of science	*CILO1,2*	Lecture, group discussion and sharing, paper reading and review, reflection on one's own teaching and learning experiences
Conceptual change in science learning - Epistemological, ontological and social/affective positions on conceptual change - Constructivism in the context of development of scientific knowledge and individual understanding of science - Critique of frameworks for changing children's ideas (e.g. socio-cultural critiques of cognitive perspectives on learning) - Role of language and the literacies of science - A multi-dimensional framework for conceptual change	*CILO1,2*	Lecture, group discussion and sharing, paper reading and review, reflection on one's own teaching and learning experiences
Learning science through inquiry - Role of procedural understanding and argumentation in learning science - Development of scientific thinking and process skills - Critique of practical work in science	*CILO1,2*	Lecture, group discussion and sharing, paper reading and review, reflection on one's own teaching and learning experiences

Assessment of science learning - Assessing declarative and procedural understanding - International comparative studies: What could they tell us about science learning? - Implications of assessment for curriculum design and learning in the classroom	*CILO*$_{2,4}$	Lecture, group discussion and sharing, paper reading and review, reflection on one's own teaching and learning experiences

4. Assessment

Assessment Tasks	Weighting (%)	CILOs
a. Reflective reports on readings relevant to selected topic areas	20%	*CILO*$_{1,2}$
b. An essay consisting of a critical review of the literature relevant to one of the topic areas, with in-depth discussion focusing on the feasibility of integrating theories with practice in that particular area of science learning (about 4000 words)	80%	*CILO*$_{1,2,3}$

5. Required Text(s)

6. Recommended Readings

Leung, Issic. K. C., Wong, N. Y., Schwarz, B., Cheung, K. L., Chan, W. S. and Kaiser, G. (2013). Competency of Prospective Chinese Mathematics Teachers on Mathematical Argumentation and Proof. The Mathematics Educator, 15(1), 81-97.

Anderson, R. D. (2002). Reforming science teaching: what research says about inquiry. Journal of Science Teacher Education, 13(1), 1-12.

Anderson, R. D. (2007). Inquiry as an organizing theme for science curricula. In S. K. Abell & N. G. Nederman (Eds.), Handbook of research on science education (pp. 807-830). Mahwah, NJ: Lawrence Erlbaum Associates.

Bell, B. (2007). Classroom assessment of science learning. In S. K. Abell & N. G. Nederman (Eds.), Handbook of research on science education (pp. 965-1006). Mahwah, NJ: Lawrence Erlbaum Associates.

Carlsen, W. S. (2007). Language and science learning. In S. K. Abell & N. G. Nederman (Eds.), Handbook of research on science education (pp. 57-74). Mahwah, NJ: Lawrence Erlbaum Associates.

Crawford, B. A. (2000). Embracing the essence of inquiry: New roles for science teachers. Journal of Research in Science Teaching, 37(9), 916-937

Driver, R., Asoko, H., Leach, J., Mortimer, E. & Scott, P. (1994) 'Constructing scientific knowledge in the classroom', Educational Researcher, vol. 23, no. 7, pp. 5–12.

Gott, R., Duggan, S., & Johnson, P. (1999a). What do practising applied scientists do and what are the implications for science education? Research in Science and Technological Education 17 (1) 97–107

Hofstein, A. & Lunetta, V. N. (2003). The Laboratory in Science Education: Foundations for the Twenty-First Century. International Journal of Science Education, 88, 28-54.

Kuhn, D. (1991). Understanding scientific reasoning. Fort Worth: Harcourt Brace Jovanovich College Publishers. Metz, K. E. (1995). Reassessment of developmental constraints on children's science instruction. Review of Educational Research, 65(2), 93-127.

Millar, R., Lubben, F., Gott, R., and Duggan, S. (1994). Investigating in the school science laboratory: Conceptual and procedural knowledge and their influence on performance. Research Papers in Education – Policy and Practice, 9(2), 207-248.

National Research Council (2007). Taking science to school: Learning and teaching science in Grades K-8. Washington: The National Academies Press.

Nederman, N. G. (2007). Nature of science : past, present, and future. In S. K. Abell & N. G. Nederman (Eds.), Handbook of research on science education (pp. 831-880). Mahwah, NJ: Lawrence Erlbaum Associates.

Osborne, J., Erduran, S., Simon, S. (2004). Enhancing the quality of argument in school science. Journal of Research in Science teaching, 41(10), 994-1020.

Ratcliffe, M, and Grace, M. (2003). Science education for citizenship. Maidenhead, Philadelphia: Open University Press.

Roberts, D. A. (2007). Scientific literacy/science literacy. In S. K. Abell & N. G. Nederman (Eds.), Handbook of research on science education (pp. 729-780). Mahwah, NJ: Lawrence Erlbaum Associates.

Sadler, T. D., and Zeidler, D. L. (2004). Student conceptualizations of the nature of science in response to a socioscientific issue. International Journal of Science Education, 26(4), 387-409.

Scott, P., Asoko, H. & Leach, J. (2007). Student conceptions and conceptual learning in science. In S. K. Abell & N. G. Nederman (Eds.), Handbook of research on science education (pp. 31-56). Mahwah, NJ: Lawrence Erlbaum Associates.

Simon, S., Erduran, S., and Osborne, J. (2006). Learning to teach argumentation: Research and development in the science classroom. International Journal of Science Education, 28 (2-3), 235-260.

Sinatra, G. (2005) The 'warming trend' in conceptual change research: The legacy of Paul R. Pintrich. Educational Psychologist, 40(.2), 107–115.

Tytler, R., Duggan, S. & Gott, R. (2001a). Dimensions of evidence, the public understanding of

Tytler, R., and Peterson, S. (2004). From “try it and see” to strategic exploration: Characterizing young children’s scientific reasoning. Journal of Research in Science Teaching, 41(1), 94-118.

Wickmann, P.-O., & Ostman, L. (2002). Learning as discourse change: A sociocultural mechanism. Science Education, 86, 601–623

Wickmann, P.-O. (2006). Aesthetic experience in science education: Learning and meaning-making as situated talk and action. London; Mahwah, New Jersey: Lawrence Erlbaum Associates.

Zeidler, D. L., Sadler, T. D., Simmons, M. L. & Howes, E. V. (2004). Beyond STS: A Research-Based Framework for Socioscientific Issues Education. International Journal of Science Education. 89, 357-377.

7. Related Web Resources

National Association for Research in Science Teaching
http://www.narst.org/
National Science Teacher Association
http://www.nsta.org/

8. Related Journals

Science Education
Journal of Research in Science Education
International Journal of Science Education
Journal of Science Teacher Education

9. OtherS