THE EDUCATION UNIVERSITY OF HONG KONG

Course Outline

(for programme development)

Part I

Programme Title	**:** Doctor of Eudcation
Programme QF Level	**:** 7
Course Title	**:** Technology for Effective Learning and Teaching of Science
Course Code	**:** SCG8012
Department	**:** Department of Science and Environment Studies
Credit Points	**:** 3
Contact Hours	**:** 39 (5 for face-to-face lesson + 34 hours for directed study)
Pre-requisite(s)	**:** Nil
Medium of Instruction	**:** English
Course Level	**:** 7

Part II

The University's Graduate Attributes and seven Generic Intended Learning Outcomes (GILOs) represent the attributes of ideal EdUHK graduates and their expected qualities respectively. Learning outcomes work coherently at the University (GILOs), programme (Programme Intended Learning Outcomes) and course (Course Intended Learning Outcomes) levels to achieve the goal of nurturing students with important graduate attributes.

In gist, the Graduate Attributes for Undergraduate, Taught Postgraduate and Research Postgraduate students consist of the following three domains (i.e. in short "PEER & I"):

- **P**rofessional **E**xcellence;
- **E**thical **R**esponsibility; **&**
- **I**nnovation.

The descriptors under these three domains are different for the three groups of students in order to reflect the respective level of Graduate Attributes.

The seven GILOs are:

1. Problem Solving Skills
2. Critical Thinking Skills
3. Creative Thinking Skills

4a. Oral Communication Skills

4b. Written Communication Skills

5. Social Interaction Skills

6. Ethical Decision Making
7. Global Perspectives

1. Course Synopsis

The learning and teaching of science has long been integrated with the use of various types of technologies since the existence of school laboratories. Nowadays, information technology (e.g. dataloggers and pocket PC), communication technology (e.g. cable and wireless networks, mobile phones and GPS devices), and digital entertainment devices (e.g. digital cameras, drones, electronic games and HD TV etc.) are emerging and penetrating both the students' and teachers' daily lives. At the same time, these technologies could enable science teachers to design many innovative and inexpensive learning activities to help their students overcome common misconceptions in science, cultivate their metacognitive learning ability, stimulate their interest of science learning, and facilitate their life-wide learning of science. This module employs some appropriate technologies (e.g. 3D visualization technology and virtual reality) and related research (e.g. multiple and multimodal representations) in science education to equip the candidates with practical pedagogiesand theoretical basis for effective applications of technology to enhance the classroom learning and teaching of science as well as the evaluation of students' science learning outcomes.

2. Course Intended Learning Outcomes ($CILO_s$)

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

$CILO_1$ demonstrate an in-depth understanding of the theoretical basis for effective applications of technology in science education;

$CILO_2$ master the essential technological skills and pedagogies for innovative design and development of technology-mediated science learning resources and activities;

$CILO_3$ critically assess students' outcomes of science learning in different technology-rich learning environment.

3. Content, CILOs and Teaching & Learning Activities

Course Content	CILOs	Suggested Teaching & Learning Activities
1. Digital technology in laboratory based and field-based learning of science - Recent development and	*CILO1,2*	Lecture Demonstration Hands-on activities Consultation and

applications of datalogging systems in science laboratory practice - Innovative design and development of low-cost computer-mediated scientific investigation activities (e.g. Arduino programming) - Remote-controlled experimentation - Exemplary use of hand-held digital technology (e.g. digital cameras, drones, smart phones and GPS) in informal and field-based learning of science		discussion
2. Theory and practice of using computer- mediated modeling and representation - Theories of modeling, representation and visualization in science learning - Current application of virtual reality and 3D visualization in science education - Computer-simulated experiments for student-centred learning of science - Open-source software and web-based open-access materials for self learning of science - Online learning platform for collaborative learning of science	*CILO1,2*	Lecture Demonstration Hands-on activities Candidate's oral presentation Consultation and discussion
3. Assessment of technology-enhanced science learning and teaching - Evaluation of students' changes in their achievement and attitudes through science learning in various technology-rich environments - Critical examination of implementation difficulties and teacher professional development - Issues and implications of using technology for science education and other school curricula	*CILO3*	Lecture Demonstration Hands-on activities Candidate's oral presentation Consultation and discussion

4. Assessment

Assessment Tasks	Weighting (%)	CILO
a) Reflective reports on reading the recent literature relevant to selected topics in 3 different parts of the content.	20%	*CILO1, 2*
b) An essay consisting of a critical evaluation of the design, development and application of a selected technology in enhancing the teaching of a chosen science topic, with in-depth discussion focusing on the students' outcomes of science learning and related educational implications (about 4000 words)	80%	*CILO1,2,3*

5. Required Text(s)

Nil

6. Recommended Readings

Barton, R. (2004). *Teaching secondary science with ICT*. Maidenhead, England: Open University Press.

Deaney, R., Hennessy, S. and Ruthven, K. (2006). Teachers' strategies for making effective use of datalogging. *School Science Review*, 88(323), 103-110.

DiPaolo, T., & Scanlon, E. (2004). Redesigning practical work: Web-based remote experimentation. In R. Holliman & E. Scanlon (Eds.), Mediating science learning through information and communications technology (pp.169-187). London: Routledge Falmer.Scanlon, E. (2013). Redesigning practical work: Web-based remote experimentation. In *Mediating Science Learning Through Information and Communications Technology* (pp. 169-187). Taylor and Francis.

Gilbert, J. K., (Ed.). (2005). *Visualization in Science Education*. Dordrecht: Springer. [Online] http://www.springerlink.com/content/g7662q/

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Holliman, R., & Scanlon, E. (Eds.) (2004). *Mediating science learning through information and communications technology*. London: Routledge Falmer.Holliman, R., & Scanlon, E. (2013). *Mediating science learning through*

information and communications technology. Taylor and Francis.

Huang, X., Yeung, Y. Y., Kong, S. C., and Gao, W. (2011). "Application of Radio Frequency Identification (RFID) in Science Education". *International Journal of Information and Education Technology*, 1(3), 254-260.

Joseph S. Krajcik, Patricia E. Simmons, and Vincent N. Lunetta (1988). A research strategy for the dynamic study of students' concepts and problem solving strategies using science software. *Journal of research in science teaching*, 25(2), 147-155.

Kong, S. C., Yeung, Y. Y., & Wu, X. Q. (2009). An Experience of Teaching for Learning by Observation: Remote-Controlled Experiments on Electrical Circuits. *Computers & Education*, 52(3), 702-717.Kulik, James A. Bangert, Robert L. Williams, George W. (1983). Effects of computer-based teaching on secondary school students. Journal of Educational Psychology, 75(1), 19-26.

Lam, C.M., Yeung, C.H. & Yeung, Y.Y. (2016). Mobile learning in Hong Kong teacher education: Pilot implementation and evaluation. In M. Carmo (Ed.), Education Applications & Development II, Chapter 11, pp.112-122. inScience Press: Lisboa, Portugal.

Marcia C. LINN, James D. SLOTTA, Hiroki TERASHIMA, Elisa STONE, & Jacquie MADHOK (2010). Designing Science Instruction using the Web-based Inquiry Science Environment (WISE). Asia-Pacific Forum on Science Learning and Teaching, 11(2), FOREWORD. [online] http://www.ied.edu.hk/apfslt/v11_issue2/foreword/

McDougall A (Ed.) (2010). *Researching IT in education: Theory, practice and future directions*. London and New York: Routledge.

Mishra, P., & Koehler, M. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record 108(6)*, 1017-1054.

Pachler, N. and Daly, C. (2011). Key issues in e-Learning: Research and practice. London and New York: Continuum International Publishing Group.

Papanastasiou, E. C., & Zembylas, M., & Vrasidas, C. (2003). Can Computer Use Hurt Science Achievement? The USA Results from PISA. *Journal of Science Education and Technology, 12(3)*, 325-332.

Pedersen, J. E., & Yerrick, R. K. (2000). Technology in Science Teacher Education: Survey of Current Uses and Desired Knowledge among Science Educators. *Journal of Science Teacher Education, 11(2)*, 131-153.

Psillos, D., & Niedderer, H. (Eds.) (2002), *Teaching and Learning in the Science Laboratory.* Boston, MA : Kluwer Academic Publishers.

Rafi Nachmias and Marcia C. Linn (1987). Evaluations of science laboratory data:

the role of computer-presented information. *Journal of research in science teaching*, 24(5), 491-506.

Scanlon, E., Morris, E., Di Paolo, T., & Cooper, M. (2002). Contemporary approaches to learning science: Technologically-mediated practical work. *Studies in Science Education*, 38, 73-114.

Selwyn, N. (2011). *Education and Technology: Key Issues and Debates*. London and New York: Continuum International Publishing Group.Selwyn, N. (2017). *Education and technology : Key issues and debates* (Second ed.). London ; New York, NY : Bloomsbury Academic, an imprint of Bloomsbury Publishing Plc

Spector, J., Merrill, M., Elen, & Bishop. (2014). *Handbook of research on educational communications and technology: Fourth edition*. Springer New York. Spector, J. M., Merrill, M. D., van Merrienboer, J. and Driscoll, M.P. (2008). *Handbook of research on educational communications and technology* (3rd ed.). London and New York: Routledge.

Tan, K. C. D., Hedberg, J.G., Koh, T.S., & Seah, W.C. (2006). Datalogging in Singapore schools: supporting effective implementations. *Research in Science & Technological Education*, 24(1), 111-127.

Tho, S. W., Chan, K.W., & Yeung, Y. Y. (2015). Technology-enhanced Physics Programme for Community-Based Science Learning: Innovative Design and Programme Evaluation in a Theme Park. *Journal of Science Education and Technology*, *24*(5), 580-594.

Tho, S. W., & Yeung, Y. Y. (2016). Technology-enhanced science learning through remote laboratory: System design and pilot implementation in tertiary education. *Australasian Journal of Educational Technology, 32*(3), 96-111.

Tremblay, E. (2010). Educating the Mobile Generation – using personal cell phones as audience response systems in post-secondary science teaching. *Journal of Computers in Mathematics and Science Teaching*, 29(2), 217-227. Chesapeake, VA: AACE.

Yeung, Y. Y. (2011). Web-based applications of 3D visualization and virtual reality in science education. In A. Méndez-Vilas (Ed.), *Education in a technological world: communicating current and emerging research and technological efforts* (pp.615-623). Badajoz, Spain: Formatex Research Center.

Yeung, Yau-yuen. (2008). Exemplars of Enhancing Physics Learning through the Use of Information Technology – Low-cost Computer-mediated Physics Experiments. *College Physics*, 20(2), 68-72.

7. Related Web Resources

Hypermedia and Self-learning Centre - http://www.eduhk.hk/has/

Science Learning Centres - http://www.sciencelearningcentres.org.uk/ Science Learning Network - http://www.sln.org/

JISC [Joint Information Systems Committee] (2004). Effective Practice with e-Learning: A good practice guide in designing for learning. [online] http://www.jisc.ac.uk/media/documents/publications/effectivepracticeelearning.pdf

8. Related Journals

Journal of Computers in Mathematics and Science Teaching

Journal of Science Education and Technology

Research and Practice in Technology Enhanced Learning

9. Academic Honesty

The University adopts a zero tolerance policy to plagiarism. For the University's policy on plagiarism, please refer to the *Policy on Academic Honesty, Responsibility and Integrity with Specific Reference to the Avoidance of Plagiarism by Students* (https://www.eduhk.hk/re/modules/downloads/visit.php?cid=9&lid=89). Students should familiarize themselves with the Policy.

10. Others

Nil