<u>Module/Course Title:</u> Design and Assessment of Educational Material in the Didactics of Mathematics and Science

- **Name of lecturer: Michael Skoumios**

- **Content outline:**
  Following topics will be covered in this course: (a) new perspectives in mathematics and science education, (b) mathematics and scientific literacy, (c) mathematics and science practices, crosscutting concepts, core ideas in mathematics and science and "three dimensional" learning, (d) students' conceptions about mathematics and science concepts, (e) mathematics and science teaching approaches, (f) constructivist learning in mathematics and science, (g) inquiry-based learning in mathematics and science, (h) design strategies for developing mathematics and science instructional materials, (i) mathematics and science education and interdisciplinary approaches, (j) developing mathematics and science instructional materials, and (k) assessing mathematics and science instructional materials.

- **Learning outcomes** *(200-500 words)***:**
  The purpose of this course is the systematic conformation of design, creation, use and evaluation procedures of instructional tools and learning materials for mathematics and science.
  At the end of the course students should be able to: (a) report the new perspectives in mathematics and science education, (b) analyse the historical and contemporary meanings of mathematics and scientific literacy and their relationship to mathematics and science education reforms, (c) identify the mathematics and science practices, the crosscutting concepts, the core ideas in mathematics and science and analyse the meaning of the term "three dimensional" mathematics and science learning, (d) report and analyse the research-based claims relating to students' conceptions about mathematics and science concepts and describe the main features of students' conceptions, (e) identify and analyse the approaches for mathematics and science teaching, (f) explain the basic principles of constructivist learning in mathematics and science, (g) analyse the meaning of inquiry-based learning in mathematics and science and identify its essential features, (h) report and analyse design strategies for developing mathematics and science instructional materials, (i) discuss about science education and interdisciplinary approaches, (j) design and develop mathematics and science instructional materials, and (k) assess mathematics and science instructional materials.

- **Recommended Reading:**

a) Basic Textbooks:

Duschl, R. A., Schweingruber, H. A., & Shouse, A. W. (2007). *Taking science to school: Learning and teaching science in grades K-8.* Washington, DC: National Academies Press.

Fibonacci (2012). *Inquiry in Mathematics Education*, (http://fibonacci.uni-bayreuth.de/resources/resources-for-implementing-inquiry.html).

National Governors Association Center for Best Practices, Council of Chief State School Officers (2010), Common Core State Standards for Mathematics, National Governors Association Center for Best Practices, Council of Chief State School Officers: Washington, D.C. (www.corestandards.org/assets/CCSSI_Math%20Standards.pdf).

National Research Council. (2012). A framework for K-12 science education: Practices, crosscutting concepts, and core ideas. Committee on Conceptual Framework for the New K-12 Science Education Standards. Board on Science Education. Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

Osborne, J. and Hennessy, S. (2003). Literature review in science education and the role of ICT: Promise, problems and future directions. A report for NESTA Futurelab (Report 6).

b) Additional References:

D'Angelo, C., Rutstein, D., Harris, C., Bernard, R., Borokhovski, E., Haertel, G. (2013). Simulations for STEM learning: Systematic review and meta-analysis (Executive Summary). Menlo Park, CA: SRI International.

Hennessy, S., Wishart, J., Whitelock, D., Deaney, R., Brawn, R., la Velle, L., McFarlane, A., Ruthven, K. & Winterbottom, M. (2007). Pedagogical approaches for technology-integrated science teaching. *Computers and Education*, 48 (1), 137-152.

NGSS Lead States. (2013). Next Generation Science Standards: For States, By States. *Washington, DC: The National Academies Press.*

OECD (2006). Assessing Scientific, Reading and Mathematical Literacy: A framework for PISA 2006. *Paris: OECD Publishing.*

OECD (2013). PISA 2015 Draft Science Framework. *Retrieved from* http://www.oecd.org/pisa/pisaproducts/Draft%20PISA%202015%20Science%20Framework%20.pdf

Skoumios, M., & Hatzinikita, V. (2006). Research-based teaching about science at the upper-primary school level. *The International Journal of Learning*, 13 (5), 29-42.

Skoumios, M. (2009) The effect of sociocognitive conflict on students' dialogic argumentation about floating and sinking. *International Journal of Environmental and Science Education*, 4 (4), 381-399.

Skoumios, M. (2013). The nature of the criteria the students use to justify their ideas during a computer assisted instruction based on socio-cognitive conflict processes. *Ubiquitous Learning: An International Journal*, 5 (3), 25-41.

Σκουμιός, Μ., & Χατζηνικήτα, Β. (2014). Αξιολογώντας τις γραπτές εξηγήσεις των μαθητών στις Φυσικές Επιστήμες. *Φυσικές Επιστήμες στην Εκπαίδευση*, 3, 9-19.

- **Learning Activities and Teaching Methods:**
  Seminar-type lesson / teamwork.

- **Assessment/Grading Methods:**
  Written work (50%) and oral exams (50%).

- **Language of Instruction:**

Greek.

- **Mode of delivery (face-to-face, distance learning):**
  Face-to-face.