X3 Course title: Design of Mathematics and Science Curriculum Programs

Instructors: Sonia Kafoussi, Michael Skoumios

Goals of the course:

The goal of the course is the discussion about critical elements of the design of Mathematics and Science Curriculum Programs.

Course contents (Syllabus)

- Basic principles of the of Mathematics and Science Curriculum Programs:
  - Epistemology of the subject
  - Scientific Literacy and its implications for curriculum design
  - Contemporary approaches in Didactics of Mathematics and Science
  - Sociocultural and Sociopolitical issues
- Examples of Curriculum Programs

Learning Objectives

The students will be able to:

- To design and assess instructional programs in the context of mathematics and science education.

- To identify critical elements of instructional programs at various levels (preschool, elementary, secondary).

- To design interdisciplinary activities.

Assessment methods

The students are required to study and present theoretical papers relevant to the course syllabus.

Άρθρα/ Papers

1.Niss, M. & Hojgaard, T. (2019). Mathematical competencies revisited. *Educational Studies in Mathematics*, 102, 9-28.
2.Sáenz , C. (2009). The role of contextual, conceptual and procedural knowledge in activating mathematical competencies (PISA). *Educational Studies in Mathematics*, 71, 123-143.
3.Boaler, J. (1999). Participation, knowledge and beliefs: a community perspective on mathematics learning. *Educational Studies in Mathematics*, 40, 259-281.
4.Fischer, J-P. et al. (2019). Should we continue to teach standard written algorithms for the arithmetical operations? The example of subtraction. *Educational Studies in Mathematics*, 101, 105-121.

5. Remillard, J., Harris, B. & Agodini, R. (2014). The influence of curriculum material design on opportunities for student learning. *ZDM Mathematics Education,* 46, 735–749.
6. Fan, L. & Zhu, Y. (2007). Representation of problem-solving procedures: A comparative look at China, Singapore, and US mathematics textbooks. *Educational Studies in Mathematics,* 66, 61-75.
7.Wijaya, A. et al. (2015). Opportunity-to-learn context-based tasks provided by mathematics textbooks. *Educational Studies in Mathematics* 89, 41-65.
8.Fan, L., Xiong, B., Zhao, D., & Niu, W. (2018). How is cultural influence manifested in the formation of mathematics textbooks? A comparative case study of resource book series between Shanghai and England. *ZDM Mathematics Education, 50***,** 787–799.
9. Kafoussi, S., Chaviaris, P. & Moutsios-Rentzos, A. (2020). Investigating parental influences on sixth graders' mathematical identity in Greece: a case study. *International Electronic Journal of Mathematics Education*, *15*(2)*,* em0572, https://doi.org/10.29333/iejme/6279
10. Sothayapetch, P., Lavonen, J., & Juuti, K. (2013). A comparative analysis of PISA scientific literacy framework in Finnish and Thai science curricula. *Science Education International,* 24 (1), 78-97.
11. Overman, M., Vermunt, D., Meijer, P., Bulte, B., & Brekelmans M. (2013). Textbook Questions in Context-Based and Traditional Chemistry Curricula Analysed from a Content Perspective and a Learning Activities Perspective. *International Journal of Science Education,* 35 (17), 2954–2978.
12. Morris, B. J., Masnick, A. M., Baker, K., & Junglen, A. (2015). An Analysis of Data Activities and Instructional Supports in Middle School Science Textbooks. *International Journal of Science Education*, 37 (16), 2708-2720
13. Arnold, J., Kremer, K., & Mayer, J. (2014). Understanding Students' Experiments - What kind of support do they need in inquiry tasks? *International Journal of Science Education*, 36 (16), 2719–2749.
14. Ravanis, K. Christidou, V., & Hatzinikita, V. (2013). Enhancing conceptual change in preschool children's representations of light: a socio-cognitive approach. *Research in Science Education*, 43 (6), 2257-2276.
15. Walker, J. & Sampson, V. (2013). Argument-Driven Inquiry: Using the laboratory to improve undergraduates science writing skills through meaningful science writing, peer-review and revisions. *The Journal of Chemical Education*, 90 (10), 1269-1274

Περιοδικά/Journals

Educational Studies in Mathematics,

ZDM Mathematics Education

Science and Education

Research in Science Education

Βιβλιογραφία /Bibliography

- Cai, J & Howson, G. (2013). Toward an International Mathematics Curriculum. In M. A. Clements et al. (Eds.), *Third International Handbook of Mathematics Education (*pp. 949-974). New York, Springer International Handbooks of Education.
- Clements, D. (2007*).* Curriculum Research: Toward a framework for "research-based curricula". *Journal for Research in Mathematics Education*, *38(1)*, 35-70.
- Davis, P. & Hersh, R. (1981). *Mathematical Experience*. Greece. [GR]
- Kafoussi, S. & Skoumpourdi, C. (2008). *Mathematics of children 4-6 years old. Numbers and Space.*Patakis, Athens, Greece. [GR]
- Kafoussi, S. & Chaviaris, P. (2013). *Mathematics classroom, family, society and mathematics education.* Patakis, Athens, Greece. [GR]
- Koleza, E. (2017). *Theory and practice in mathematics teaching.* Gutenberg, Athens, Greece. [GR]
- 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.
- NGSS Lead States. (2013). Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press.
- Streefland, L. (2000). *Realistic mathematics in primary education.* Leader Books Athens, Greece. [GR]