Linz STEM Education Course Descriptions – 2018-2019

Term 1: Introduction to STEM education research

Thursdays 13:45-15:15 and 15:30-17:00

In this course, we will look at typical assumptions about STEM education and educational research, as well as contentious issues in historic and current debates together with basic educational research designs. We will consider past trends in STEM education and social science research methodologies to understand where we are now as well as learn about current developments in the field. The course will introduce students to various approaches and discourses within the broader frame of STEM education research. We will review relevant literature and consider a variety of topics in the field; formulate possible research questions and develop initial research designs according to students' various interests. We will also pay particular attention to research design issues, i.e. how one designs a study so that can answer particular research questions; which are the basic elements of research designs; what are the most typical methodologies and methods in education research. Accordingly, we will discuss the distinction between research designs and methods and how methods can form the basis of knowledge claims about a phenomenon of study.

Term 2: Introduction to data collection, analysis, and reporting in STEM education research

Thursdays 13:45-15:15 and 15:30-17:00

This course will offer additional help for students starting their own research, either following qualitative, quantitative, mixed methods or theoretical approaches. We will explore educational methodologies and methods in detail as well as work on practical issues of data collection, analysis and reporting. We will also discuss data collection within both qualitative and quantitative methodologies such as surveys, interviews, observations, documentary analyses etc. Then, we will delve into qualitative and statistical analysis techniques. Finally, issues around writing up and reporting results of studies in both theses and academic publications will be explored.

All year: Advanced methods in STEM education research

Fridays 9:00-12:00

This course is aimed for students completed the introductory STEM education research courses or have some experience in research methods. Nevertheless, it is advantageous for any student to attend the sessions and learn about advanced methods in STEM education research. In the sessions, we will discuss data collection and analysis methods in depth. Also, we will explore issues relevant for participants writing masters, PhD theses or academic papers.

Proposed readings

General Education Research

Cobb, P., Confrey, J., diSessa, A., Lehrer, R., & Schauble, L. (2003). Design Experiments in Educational Research. *Educational Researcher*, *32*(1), 9–13.

Dunkin, M. J. (1996). Types of errors in synthesizing research in education. *Review of Educational Research*, *66*(2), 87–97.

Field, A. (2009). Discover statistics using SPSS. SAGE Publications Ltd, London, UK.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational researcher*, *33*(7), 14–26.

Lyle, J. (2003). Stimulated recall: A report on its use in naturalistic research. British Educational Research Journal, 29(6), 861–878.

Moss, P. A., Phillips, D. C., Erickson, F. D., Floden, R. E., Lather, P. A., & Schneider, B. L. (2009). Learning from our differences: A dialogue across perspectives on quality in education research. *Educational Researcher*, *38*(7), 501–517.

Oancea, A. (2005). Criticisms of educational research: key topics and levels of analysis. *British Educational Research Journal*, *31*(2), 157–183.

Pring, R. (2005). *Philosophy of education: Aims, theory, common sense and research*. Continuum International Publishing Group. Chapter 3.

Symonds, J. E., & Gorard, S. (2010). Death of mixed methods? Or the rebirth of research as a craft. Evaluation & Research in Education, 23(2), 121–136.

Weston, C., Gandell, T., Beauchamp, J., McAlpine, L., Wiseman, C., & Beauchamp, C. (2001). Analyzing interview data: The development and evolution of a coding system. Qualitative Sociology, 24(3), 381–400.

Wilson, E. (2012). School-based research: a guide for education students. Sage. Chapter 7.

Mathematics Education

Davis, B. (2001) Why teach mathematics to all students? For the Learning of Mathematics, 21 (1), 17-24.

Heymann, H.W. (2004) Why Teach Mathematics?: A Focus on General Education. New York: Springer

Huckstep, P. (2000) The utility of mathematics education: some responses to scepticism, For the Learning of Mathematics, 20 (2), 8-13

Geometry

Clements, D. H. (2003). Teaching and learning geometry. In J. Kilpatrick, W. G. Martin, and D. Schifter (Eds.), A research companion to Principles and Standards for School Mathematics (pp. 151–178). Reston, VA: National Council of Teachers of Mathematics.

Jones, K. (2000), Providing a Foundation for Deductive Reasoning: students' interpretations when using dynamic geometry software and their evolving

mathematical explanations, Educational Studies in Mathematics, 44 (1-2), 55-85.

Technology

Laborde, C. (2001). Integration of technology in the design of geometry tasks with Cabri-Geometry. International Journal of Computers for Mathematical Learning, 6, 283-317.

Ruthven, K., Hennessy, S., & Deaney, R. (2008). Constructions of dynamic geometry: A study of the interpretative flexibility of educational software in classroom practice. Computers and Education, 51(1), 297-317.

Ruthven, K. (2009). Towards a naturalistic conceptualisation of technology integration in classroom practice: The example of school mathematics. Education & Didactique 3(1), 131-152

Ruthven, K., Deaney, R., & Hennessy, S. (2009). Using graphing software to teach about algebraic forms: A study of technology-supported practice in secondary-school mathematics. Educational Studies in Mathematics 71(3), 279-297.

Stylianides, G. J., & Stylianides, A. J. (2005). Validation of solutions of construction problems in Dynamic Geometry Environments. International Journal of Computers for Mathematical Learning, 10, 31-47.

Affective factors

Grootenboer, P., & Hemmings, B. (2007). Mathematics performance and the role played by affective and background factors. Mathematics Education Research Journal, 19 (3), 3–20.

Malmivuori, M-L. (2006) Affect and self regulation, Educational Studies in Mathematics, 63: 149–164

Op ’t Eynde, P., De Corte, E., & Verschaffel, L. (2006). Epistemic dimensions of students’ mathematics-related belief systems. International Journal of Educational Research, 45 (1), 57–70.

Teacher Knowledge

Ball, D.L. (1990). The mathematical understandings that prospective teachers bring to education. Elementary School Journal, 90, 449-466.

Ball, D.L., Thames, M.H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? Journal of Teacher Education, 59(5), 389-407.

Goulding, M., Rowland, T. and Barber, P. (2002) Does it matter? Primary teacher trainees’ subject knowledge in mathematics. British Educational Research Journal, 28(5), 689-704.

Rowland, T., Huckstep, P. and Thwaites, A. (2005) Elementary teachers' mathematics subject knowledge: the knowledge quartet and the case of Naomi. Journal of Mathematics Teacher Education 8(3) pp. 255-281.

Statistics and Probability

Jones, G., Langrall, C., Thornton, C. and Mogill, T. (1999) Students' probabilistic thinking in instruction, Journal for Research in Mathematics Education, 30 (5), 487-519.

Castro Sotos, A. E., Vanhoof, S., Van den Noortgate, W. and Onghena, P. (2007). Students' misconceptions of statistical inference: a review of the empirical evidence from research on statistics education. Educational Research Review. 2(2), 98-113.

Garfield, J.,and Ben-Zvi, D. (2007) How Students Learn Statistics Revisited: A Current Review of Research onTeaching and Learning Statistics. International Statistical Review, 75(3), 372–396.

Assessment

Ruthven, K. (2002) Assessment in mathematics education. In L. Haggarty (ed.) Teaching Mathematics in Secondary Schools (Routledge-Falmer, London) pp. 176-191.

Williams, J., and Ryan, J. (2000). National testing and the improvement of classroom teaching: Can they coexist? British Educational Research Journal, 26(1), 49-73.

William, D., Lee, C., Harrison, C. and Black, P. (2004). Teachers developing assessment for learning: impact on student achievement. Assessment in Education, 11(1), 49-65.