

Professor Hugh Burkhardt

Biography

Hugh Burkhardt, a theoretical physicist and educational design leader, was Director of the University's Shell Centre for Mathematical Education from 1976 to 1992, and of many Shell Centre projects since then. He is the founder of ISDDE, the International Society for Design and Development in Education. His published work in mathematics education focuses on assessment, mathematical modelling, educational design and development, and the challenges of systemic change.

In 2013 he won the ISDDE Prize for excellence in educational design for "his leadership of the Shell Centre for Mathematical Education, his contributions to a large number of its influential products, and the development of its engineering research methodology" with its emphasis on materials that have direct impact on practice. Along with his Shell Centre colleague Malcolm Swan, he was in 2016 the first recipient of the International Commission on Mathematical Instruction's Emma Castelnuovo Award "for excellence in the practice of mathematics education".

Recent references

- Burkhardt, H. & Schoenfeld, A. (2021) Not just "implementation": The synergy of research and practice in an engineering research approach to educational design and development. *ZDM Mathematics Education*, 53(5) DOI: 10.1007/s11858-020-01208-z
- Burkhardt, H. (2021). Modelling in School Mathematics: Past achievements – Current challenges. In G. A. Stillman, W. Blum & G. Kaiser (Eds), *Mathematical modelling and applications, ICTMA 19* (pp. 529–539). Dordrecht: Springer
- Burkhardt, H. & Pead, D. (2020) 30 design strategies and tactics. *Educational Designer*, 4(13). ISSN 1759-1325 Retrieved from: <http://www.educationaldesigner.org/ed/volume4/issue13/article53/>
- Burkhardt, H. (2019) Improving Policy and Practice. *Educational Designer*, 3(12). Retrieved from: <http://www.educationaldesigner.org/ed/volume3/issue12/article46/>

Books

- The Learning and Teaching of Mathematical Literacy*. in preparation
- The Mathematics Curriculum: towards the Year 2000*. Hugh Burkhardt, John Malone & Christine Keitel (Eds.) Perth: Curtin University, 1989.
- Problem Solving - a World View*. Hugh Burkhardt, Susie Groves, Alan Schoenfeld & Kaye Stacey (Eds). Nottingham: Shell Centre for Mathematical Education, 1986.
- The Real World and Mathematics*, Hugh Burkhardt, Blackie-Birkhauser: Glasgow, 1981

Other selected references (T – teaching materials developed by the Shell Centre team)

- Burkhardt, H. & Schoenfeld, A. H. (2019). Formative Assessment in Mathematics. In R. Bennett, G. Cizek, & H. Andrade (Eds), *Handbook of Formative Assessment in the Disciplines*, pp 35-67. New York: Routledge.

- T** Wake, G., Burkhardt, H., Crust, R. and Pead, D. (2019) Mathematical Modelling: Special Project for *re(Solve) Maths by Inquiry*. Canberra: Australian Academy of Sciences. <https://www.resolve.edu.au/mathematical-modelling-introduction?lesson=1666>
- Burkhardt, H. & Schoenfeld, A. H. (2018). Assessment in the service of learning: Challenges and opportunities. In G. Nortvedt & N. Buchholtz (Eds.), *Assessment in mathematics education: Responding to issues regarding methodology, policy and equity, a special issue of ZDM*, DOI: 10.1007/s11858-018-0937-1.
- Burkhardt, H. (2018). Ways to teach modelling – a 50 year study, *ZDM*, 50(1), 61-75. DOI 10.1007/s11858-017-0899-8
- Burkhardt, H., & Swan, M. (2018). Teaching Modelling and Systemic Change, In G. A. Stillman, W. Blum & G. Kaiser (Eds.), *Mathematical modelling and applications, ICTMA 17* (pp. 529–539). Dordrecht: Springer
- Burkhardt, H., & Swan, M. (2017). Design and development for large-scale improvement. Emma Castelnuovo Award lecture in G. Kaiser (Ed.) *Proceedings of the 13th International Congress on Mathematical Education*, pp 177-200 Cham: Springer International Publishing.
- Kloosterman, P., & Burkhardt, H. (2017). Assessment in the era of teacher accountability. In J. Cai (Ed.), *Compendium for research in mathematics education*. Reston, VA: National Council of Teachers of Mathematics.
- T** Burkhardt, H., Swan, M. and the Shell Centre team (2016) Adaptable Tools for School and District Leaders. Mathematics Network of Improvement Communities (Math NIC) <https://www.mathnic.org>
- Burkhardt, H. (2016). Mathematics Education Research: a strategic view. In English, L. and Kirshner, D. (Eds.) *Handbook of International Research in Mathematics Education, 3rd Edn*. London: Taylor and Francis.
- T** Shell Centre (2011-2015). Swan, M., Crust, R., Burkhardt, H. et al. Mathematics Assessment Project, teaching materials for formative and summative assessment with associated professional development <http://map.mathshell.org.uk/materials/index.php>
- Smarter Balanced Assessment Consortium. (2015). Content Specifications for the Summative Assessment of the Common Core State Standards for Mathematics. Downloaded from <http://www.smarterbalanced.org/assessments/development/mathematics-content-specifications/>
- Burkhardt, H. (2014). *The five per cent solution*. In *Perspectives*, AQA Centre for Education Research and Practice. Retrieved from <https://cerp.aqa.org.uk/perspectives/five-per-cent-solution>
- Swan, M. and Burkhardt, H. (2014) *Lesson design for formative assessment*, Educational Designer, 2(7). Retrieved from: <http://www.educationaldesigner.org/ed/volume2/issue7/article24>
- Burkhardt, H. (2014). *Curriculum design and systemic change*. In Y. Li & G. Lappan (Eds.), *Mathematics curriculum in school education*. Heidelberg: Springer.
- Wake, G. D., & Burkhardt, H. (2013). Understanding the European policy landscape and its impact on change in mathematics and science pedagogies. *ZDM*, 45(6), 851–861. doi:10.1007/s11858-013-0513-7
- Burkhardt, H. and Swan, M. (2013) *Task design for systemic improvement: principles and frameworks* Paper submitted to ICMI Study 22.
- Burkhardt, H. (2013). Methodological issues in research and development. In Y. Li & J. N. Moschkovich (Eds.), *Proficiency and beliefs in learning and teaching mathematics - Learning from Alan Schoenfeld and Günter Törner*. Rotterdam: Sense Publishers.

- Burkhardt, H. and Li, Y. (2013). About Alan H. Schoenfeld and his work. In Y. Li & J. N. Moschkovich (Eds.), *Proficiency and beliefs in learning and teaching mathematics - Learning from Alan Schoenfeld and Günter Törner*. Rotterdam: Sense Publishers.
- Swan, M. and Burkhardt, H. (2012) *Designing Assessment of Performance in Mathematics: A Designer Speaks*. Educational Designer, 2(5).
Retrieved from: <http://www.educationaldesigner.org/ed/volume2/issue5/article19>
- ISDDE (2012) Black, P., Burkhardt, H., Daro, P., Jones, I., Lappan, G., Pead, D., Stephens, M. *High-stakes Examinations to Support Policy*. Educational Designer, 2(5). Retrieved from: <http://www.educationaldesigner.org/ed/volume2/issue5/article16>
- (Schoenfeld and Burkhardt 2012) Draft Content Specifications for the Summative Assessment of the Common Core State Standards for Mathematics, SMARTER Balanced Assessment Consortium, Alan Schoenfeld and Hugh Burkhardt, principal authors, Retrieved from <http://www.mathshell.com/papers.php>
- Burkhardt, H. (2012) *Modelling Examples and Modelling Projects: 2 Overview* in G. Kaiser et al. (eds.), *Trends in Teaching and Learning of Mathematical Modelling: ICTMA14*, DOI 10.1007/978-94-007-0910-2_50,
- Daro, P. and Burkhardt, H. (2012) A population of assessment tasks, *J. Mathematics Education at Teachers College* 3, 19-25
- Burkhardt, H. (2012) *50 years of teaching modelling – experience in England*, in Blum, W., Borromeo Ferri, R., & Maaß, K. (eds.), *Mathematikunterricht im Kontext von Realität, Kultur und Lehrprofessionalität*, Wiesbaden: Springer
- Burkhardt, H. (2009) *On Strategic Design*. Educational Designer, 1(3). Retrieved from: <http://www.educationaldesigner.org/ed/volume1/issue3/article9>
- Burkhardt, H. (2008). *Quantitative Literacy for All* in Madison, B. L. and Steen, L. A. Calculation vs Context: Quantitative Literacy and its implications for Teacher Education, pp 137-162. Washington, DC: Mathematical Association of America. Downloaded as <https://www.maa.org/sites/default/files/pdf/QL/cvc/CalcVsContext.pdf>
- T** Swan, M., Burkhardt, H. & the Shell Centre team. (2008). Bowland Maths Professional Development Modules. <https://www.bowlandmaths.org.uk/pd/index.html>
- T** Burkhardt, H., Swan, M., & Pead, D. (2008). How risky is life? Bowland Maths Case study. https://www.bowlandmaths.org.uk/projects/how_risky_is_life.html
- Burkhardt, H. (2007). *Improving educational design and student learning: What can good educational design achieve and how?* CIEAEM invited paper, Dobogoko Hungary July 2007.
- Burkhardt, H. (2007). *Assessing Mathematical Proficiency: What is important?* In A. H. Schoenfeld (Ed.), *Assessing Students' Mathematics Learning: Issues, Costs and Benefits*. Volume XXX. Mathematical Sciences Research Institute Publications. Cambridge: Cambridge University Press.
- Burkhardt, H. and Bell, A.W., (2007) *Problem Solving in the United Kingdom*. Zeitschrift für Didaktik der Mathematik. **39**:395–403
- Steen, L.A., Turner, R., Burkhardt, H. (2007) Developing mathematical literacy, in W. Blum, P. L. Galbraith, H-W. Henn, & M. Niss (Eds.) (2007). *Modelling and Applications in Mathematics Education*. The 14th ICMI Study. New York: Springer.
- Muller. E. R., Burkhardt, H. et al. (2007). *Applications and Modelling in Mathematics Education*. in W. Blum, P. L. Galbraith, H-W. Henn, & M. Niss (Eds.) (2007). *Modelling and Applications in Mathematics Education*. The 14th ICMI Study. New York: Springer.

- Burkhardt, H. (2006). *Functional Mathematics and Teaching Modelling*, in C. Haines, P. Galbraith, W. Blum, W. and S. Khan (Eds.), *Mathematical Modelling (ICTMA 12): Education, Engineering and Economics*, Chichester: Horwood Publishing ISBN: 1-904275-20-6
- Burkhardt, H. (2006). *Making mathematical literacy a reality in classrooms*, in C. Haines, P. Galbraith, W. Blum, W. and S. Khan (Eds.), *Mathematical Modelling (ICTMA 12): Education, Engineering and Economics*, Chichester: Horwood Publishing ISBN: 1-904275-20-6
- Burkhardt, H. (2006). From design research to large-scale impact: Engineering research in education. in J. Van den Akker, K. Gravemeijer, S. McKenney, & N. Nieveen (Eds.), *Educational design research*. (pp. 121-150). London: Routledge.
- Burkhardt, H., with contributions by Pollak H.O. (2006) *Modelling in Mathematics Classrooms: reflections on past developments and the future*. Zeitschrift fur Didaktik der Mathematik. **38** (2)
- Burkhardt, H., Bell, A., Pead, D. and Swan, M. (2006) *Making Functional Mathematics Happen*, Comments to the British Government, Shell Centre Publications.
- T** MARS (2005). The MARS Shell Centre Team: Swan, M., Crust, R., Pead, D., Burkhardt, H. et al., for the Qualifications and Curriculum Authority. *Developing Problem Solving* 6 volumes of teaching materials. London: nferNelson.
- Burkhardt, H. (2004). Mathematical Modelling in Teacher Education – Experiences from a Modelling Seminar. In: Durand-Guerrier, V., Soury-Lavergne, S. & Arzarello, F. (Eds), CERME-6 – Proceedings of the Sixth Congress of the European Society for Research in Mathematics Education. INRP, Lyon 2010, 2046-2055
- Burkhardt, H. (2004). Establishing Modelling in the Curriculum: barriers and levers. ICMI Study 14 on modelling.
- Burkhardt, H., & Schoenfeld, A. H. (2003). Improving educational research: Toward a more useful, more influential, and better-funded enterprise. *Educational Researcher*, 32(9), 3–14.
- T** MARS (2001–2004) Crust, R., Burkhardt H. and the MARS team. *Balanced Assessment in Mathematics*. Annual tests for Grades 3 through 10, 2001–2004. Monterey, CA: CTB/McGraw-Hill
- T** MARS (2002–2004). The MARS Shell Centre Team: Pead, D., Swan, M., Crust, R., Ridgway, J., Burkhardt, H. et al., for the Qualifications and Curriculum Authority. *World Class Tests of Problem Solving in Mathematics, Science, and Technology*. London: nferNelson.
- Burkhardt H and Pead D, (2002) Computer-based Assessment: a platform for better tests?, a chapter in *Whither assessment?*, Richardson C (ed), London: Qualifications and Curriculum Authority.
- Burkhardt H, (2001) The Assessment of Problem Solving Skills in *Assessing Gifted and Talented Children*, Richardson C (ed), London: Qualifications and Curriculum Authority.
- Burkhardt H, (2001) World Class Assessment: principles, practice and problem solving in *Assessing Gifted and Talented Children*, Richardson C (ed), London: Qualifications and Curriculum Authority.
- Swan M, Ridgway J E and Burkhardt H, (2001) *Assessing Mathematical Thinking* In Holton, D. (ed), *Report of ICMI study on Assessing Undergraduate Mathematics*.
- Ridgway, J., Crust, R., Burkhardt, H., Wilcox, S., Fisher, L., and Foster D. (2000). *MARS Report on the 2000 Tests*. Mathematics Assessment Collaborative, San Jose, CA.
- T** MARS (1995-98). MARS Berkeley-Harvard-Michigan State-Shell Centre Balanced Assessment Project Team, *Balanced Assessment for the Mathematics Curriculum*. 8 volumes for classroom use in Grades 3-12, Parsippany, NJ: Pearson Learning/Dale Seymour Publications.
- Bell A, Burkhardt H and Swan M (1992) *Balanced Assessment of Mathematical Performance; Assessment of Extended Tasks; Moving the System: The Contributions of Assessment*;_three

- chapters in Lesh, R ; Lamon, J (eds.) *Assessment of Performance in School Mathematics* American Association for the Advancement of Science, 1992.
- Burkhardt H and Fraser RE (1992) *An Overview in Influence of Computers and Informatics on Mathematics and its Teaching*, Ed A Ralston et al, UNESCO 1992.
- Burkhardt, H. (1992). Classroom observation in courseware development. *International Journal of Educational Research*, 17, 87-98
- Burkhardt, H. (1990). Specifying a national curriculum. In I. Wirszup, & R.Streit (Eds.), *Developments in school mathematics around the world* 2 98-111. Reston, VA: National Council of Teachers of Mathematics.
- Burkhardt H, Fraser R E and Ridgway J (1990) *The Dynamics of Curriculum Change in Developments in School Mathematics Around the World* 2 3-30, Ed I Wirszup and R Streit, Reston, VA: National Council of Teachers of Mathematics 1990.
- Gillespie, J., Binns, B. , Burkhardt, H., & Swan, M. (1989). Assessment of mathematical modelling. In W. Blum, J. Berry, R. Biehler, I. D. Huntley, G. Kaiser-Meßmer, & L. Profke (Eds), *Applications and Modelling in Learning and Teaching Mathematics* (pp. 144-152). Chichester: Ellis Horwood.
- T** Shell Centre (1987-89) Swan, M., Binns, B., & Gillespie, J., and Burkhardt, H, with the Shell Centre team *Numeracy Through Problem Solving: five modules for teaching and assessment: Design a Board Game, Produce a Quiz Show, Plan a Trip, Be a Paper Engineer. Be a Shrewd Chooser*, Harlow, UK: Longman, downloadable from <http://www.mathshell.com>
- Burkhardt, H. (1988). The roles of theory in a "systems" approach to mathematical education, article in honor of prof. Hans-Georg Steiner's 60th birthday. *International Reviews on Mathematical Education, ZDM*, 5, 174-177.
- Phillips, R., Burkhardt, H., Fraser, R., Coupland, J., Pimm, D., & Ridgway, J. (1988). Learning activities & classroom roles with and without the microcomputer. *Journal of Mathematical Behavior*, 6, 305-338.
- Burkhardt, H. (1987). *Curricula for active mathematics*. In I. Wirszup, & R.Streit (Eds.), *Developments in school mathematics around the world* 1 321-361. Reston, VA: National Council of Teachers of Mathematics **introduced what every teacher knows: WYTIWYG**
- Burkhardt, H., Groves, S., Schoenfeld, A., Stacey, K. (1985) *Problem Solving – a world view*. Nottingham, U.K.: Shell Centre Publications.h
- T** Swan, M. with Pitts, J., Fraser, R., and Burkhardt, H, and the Shell Centre team (1985), *The Language of Functions and Graphs*, Manchester, U.K.: Joint Matriculation Board and Shell Centre for Mathematical Education, downloadable from <http://www.mathshell.com>
- T** Shell Centre (1984) Swan, M., Pitts, J., Fraser, R., and Burkhardt, H, with the Shell Centre team, *Problems with Patterns and Numbers*, Manchester, U.K: Joint Matriculation Board and Shell Centre for Mathematical Education, downloadable from <http://www.mathshell.com>
- Phillips, R., Burkhardt, H., Fraser, R., Coupland, J., Pimm, D., & Ridgway, J. (1984). Computer-based teaching. *Ergonomics*, 27, 243-25`8.
- Burkhardt, H. (1983). Applications, Modelling and Teacher Education. In Zweng, M., Green, T., Kilpatrick, J., Pollak, H., and Suydam, M. *Proceedings of the Fourth International Congress on Mathematical Education*, pp 226-229, Boston; Basel; Stuttgart: Birkhauser
- Burkhardt, H. (1981). *The Real World and Mathematics*. Blackie-Birkhauser; reprinted 2000, Nottingham, U.K Shell Centre Publications.
- Treilibs, V., Burkhardt, H., & Low, B. (1980). *Formulation processes in mathematical modelling*, Nottingham: Shell Centre Publications.

Beeby T, Burkhardt H, Fraser R E (1979) *SCAN: a systematic classroom analysis notation for mathematics classrooms*. Nottingham: Shell Centre 1980.

T Burkhardt, H., & Wishart, D. M. G. (1967). *Broad Spectrum Applied Mathematics*. unpublished lecture notes, University of Birmingham School of Mathematical Sciences

T Burkhardt, H. (1964). *Modelling with Mathematics*. unpublished lecture notes, University of Birmingham, Department of Mathematical Physics