

## Course proposal

# Teachers' Knowledge and Technology Integration

### Teacher

Helena Rocha (<https://www.researchgate.net/profile/Helena-Rocha-8>)

### Course description

The integration of digital technology in the learning of Mathematics has proved to be challenging for the teachers. Among the influences on this integration is the teachers' professional knowledge. Since the work of Shulman (and his PCK – Pedagogical Content Knowledge construct emphasizing the relevance of the content but also of a pedagogical domain, developed and clarified by Ball and colleagues in the MKT – Mathematical Knowledge for Teaching model), several authors discussed the knowledge needed to teach mathematics and specifically to do it using technology. In this course we will start from an understanding of the roots of the research on teachers' knowledge (discussing conceptualizations from Shulman -PCK-, Ball and colleagues -MKT-, and Rowland -Knowledge Quartet-), moving to the research on teachers' knowledge with a focus on technology (discussing conceptualizations from Mishra and Koehler -TPACK-, Rocha -KTMT-, Thomas and Hong -MPTK-). The course will guide students from the initial models on teachers' knowledge, discussing the evolution of the models used in the research, analyzing the differences and similarities between them and reflecting on how they are being used in research. A look to the future and to the development to be expected for the existing models will also be addressed, intending to promote the students' capacity to develop research in the field.

### Course period

November-December 2023

### Course References

- Ball, D., Thames, M., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, 59(5), 389-407. <https://doi.org/10.1177/0022487108324554>
- Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017-1054. <https://doi.org/10.1111/j.1467-9620.2006.00684.x>
- Rocha, H. (2020). Using tasks to develop pre-service teachers' knowledge for teaching mathematics with digital technology. *ZDM*, 52(7), 1381-1396. <https://doi.org/10.1007/s11858-020-01195-1>
- Rowland, T., Huckstep, P., & Thwaites, A. (2005). Elementary teachers' mathematics subject knowledge: The knowledge quartet and the case of Naomi. *Journal of Mathematics Teacher Education*, 8(3), 255-281. <https://doi.org/10.1007/s10857-005-0853-5>
- Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14. <https://doi.org/10.3102/0013189X015002004>

Thomas, M. O. J., & Hong, Y. Y. (2013). Teacher integration of technology into mathematics learning. *International Journal for Technology in Mathematics Education*, 20(2), 69-84.

### Credits and Hours

2 credits, both on lectures (8 hours), for a total of 16 hours.

### Exam Modality

Paper presentation. Students present the content of 2 papers suggested by the teacher. No groups are allowed.

### Teacher(s) CV

Attached a 3 pages CV for each teacher proposing the course.

### Teacher(s) Main Publications

10 main publications in the last 15 years

1. Sacristán, A., Faggiano, E., Santacruz-Rodríguez, M., & **Rocha**, H. (2024). Policies and implementations for technology use in mathematics education: perspectives from around the world. In B. Pepin, G. Gueudet, & J. Choppin (Eds.), *Handbook of digital resources in mathematics education*. Springer. [https://doi.org/10.1007/978-3-030-95060-6\\_52-1](https://doi.org/10.1007/978-3-030-95060-6_52-1)
2. **Rocha**, H. (2023). The impact of teachers' knowledge on the connection between technology supported exploration and mathematical proof. *European Journal of Science and Mathematics Education*, 11(4), 635-649. <https://doi.org/10.30935/scimath/13285>
3. **Rocha**, H. (2023). Analyzing teachers' knowledge based on their approach to the information provided by technology. *European Journal of Science and Mathematics Education*, 11(1), 132-145. <https://doi.org/10.30935/scimath/12522>
4. **Rocha**, H. (2022). Contribution of the analysis of the mathematical concordance to understand the teachers' KTMT. *Journal of Curriculum and Teaching*, 11(8), 412-422. <https://doi.org/10.5430/jct.v11n8p412>
5. Faggiano, E., **Rocha**, H., Sacristan, A., & Santacruz-Rodríguez, M. (2021). Towards pragmatic theories to underpin the design of teacher professional development concerning technology use in school mathematics. In A. Clark-Wilson, A. Donevska-Todorova, E. Faggiano, J. Trgalova & H-G. Weigand (Eds.) *Mathematics Education in the Digital Age: Learning, Practice and Theory* (pp. 42-68). Routledge. <https://www.routledge.com/Mathematics-Education-in-the-Digital-Age-Learning-Practice-and-Theory/Clark-Wilson-Donevska-Todorova-Faggiano-Trgalova-Weigand/p/book/9780367684525>
6. **Rocha**, H. (2020). Using tasks to develop pre-service teachers' knowledge for teaching mathematics with digital technology. *ZDM Mathematics Education*, 52(7), 1381-1396. <https://doi.org/10.1007/s11858-020-01195-1>
7. **Rocha**, H. (2020). Graphical representation of functions using technology: a window to teacher knowledge. *Teaching Mathematics and its Applications*, 39(2), 105-126. <https://doi.org/10.1093/teamat/hrz011>
8. Viseu, F. & **Rocha**, H. (2020). Interdisciplinary technological approaches from a mathematics education point of view. In L. Leite, E. Oldham, A. Afonso, F. Viseu, L. Dourado, & H. Martinho (Eds.), *Science and mathematics education for 21st century citizens: challenges and ways forward* (pp. 209-229). Nova Science Publishers.

<https://novapublishers.com/shop/science-and-mathematics-education-for-21st-century-citizens-challenges-and-ways-forwards/>

9. **Rocha**, H. (2019). Mathematical proof: from mathematics to school mathematics. *Philosophical Transactions of the Royal Society A*, 377(2140), 1-12. <http://dx.doi.org/10.1098/rsta.2018.0045>
10. **Rocha**, H. (2016). Teacher's representational fluency in a context of technology use. *Teaching Mathematics and its Applications*, 35(2), 53-64. <https://doi.org/10.1093/teamat/hrw005>

## CURRICULUM VITAE – OCTOBER 2023 (SHORT)

### PERSONAL DATA

Name	Nationality	e-mail
Helena Rocha	Portuguese	<a href="mailto:hcr@fct.unl.pt">hcr@fct.unl.pt</a>
Orcid: 0000-0003-3865-7422	Scopus ID: 57205728583	Researcher ID: ABI-4250-2020

### EDUCATION

PhD in Education – Didactic of Mathematics	Univ. de Lisboa, Instituto Educação
Master in Education – Didactic of Mathematics	Univ. de Lisboa, Fac. de Ciências
Postgraduate studies in Mathematics Education	Univ. de Lisboa, Fac. de Ciências
Degree in Mathematics	Univ. de Lisboa, Fac. de Ciências

### AFFILIATION

2013 - current	Assistant professor	Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa (FCT NOVA)
<b>POSITIONS</b>		
2018 - current	Coordinator of the Master on Mathematics Education	Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa (FCT NOVA)
<b>OTHERS</b>		
2018/6-2018/7	Invited researcher	Universität Bonn, Hausdorff Center for Mathematics, Germany
2016 - 2017	Invited professor	École Normale Supérieure de Lyon, France

### PROJECTS (FROM THE LAST 5 YEARS)

2023 - current	Mathematics teachers in a technologic society (principal investigator) 2022.03892.PTDC	Foundation for Science and Technology, Portugal
2018 - 2022	Curricular innovation and success in mathematics (team member) PTDC/CED-EDG/32422/2017	Foundation for Science and Technology, Portugal
2016 - 2019	Hilbert's 24th problem (team member) PTDC/MHC-FIL/2583/2014	Foundation for Science and Technology, Portugal

### SUPERVISION OF PHD STUDENTS

2021 – ongoing	STEAM approach in teaching practices of Mathematics in Basic School	Patrícia Teixeira (with grant)
2020 – ongoing	The mathematics teachers' professional knowledge and the integration of different technologies into their practices	Maria do Carmo Botelho (with PhD grant)
2020 – ongoing	The teacher's professional knowledge in an interdisciplinary context: a study on the articulation between Chemistry and Mathematics	Tânia Coelho

2019 – ongoing	Mathematics teacher's professional knowledge: an experience in a collaborative context	Ana Martinez
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### SUPERVISION OF MASTER STUDENTS (SOME EXAMPLES OUT OF 22 CONCLUDED THESIS)

The articulation between the different representations of functions and their derivatives in a context with graphing calculators	Alexandra Carvalho	2023
The articulation between different representations of rational functions in the resolution of tasks of different nature with the graphing calculator	Laura Gorricha	2022
Mathematical proof: the impact of the graphing calculator	Inês Dias	2019

### EDITORIAL ACTIVITIES

2023 - current	journal <i>Quadrante</i> (ISSN 2183-2838, indexed: Latindex, Qualis)	Associate editor
2021 - current	journal <i>Research in Mathematics Education</i> (ISSN 1479-4802, indexed: Scopus Q1, WOS)	Editorial board
2014 - 2021	journal <i>Educação e Matemática</i> (ISSN 0871-7222, indexed: Latindex, Qualis)	Editor in chief
2022 - current 1997 - 2014	journal <i>Educação e Matemática</i> (ISSN 0871-7222, indexed: Latindex, Qualis)	Editor

### REVIEW ACTIVITY IN SCOPUS/WOS JOURNALS (EXAMPLES FROM THE LAST 5 YEARS)

2023 - current	ZDM Mathematics Education	Springer
2021 - current	Research in Mathematics Education	Taylor & Francis
2021 - current	Journal of Mathematics Teacher Education	Springer
2021 - current	Educational Studies in Mathematics	Springer
2019 - current	Journal for Research in Mathematics Education	National Council of Teachers of Mathematics

### SCIENTIFIC/ORGANIZATION COMMITTEES OF CONFERENCES (EXAMPLES FROM THE LAST 5 YEARS)

2024	SIMPEMAT – 6.º Simpósio Internacional de Pesquisa em Educação Matemática (Brazil) <a href="https://eventos.uepb.edu.br/sipemat/">https://eventos.uepb.edu.br/sipemat/</a>	Scientific committee
2023	VII INCTE – International Congress on Teacher Education <a href="https://incte.ipb.pt/#filter=comissoes.pt">https://incte.ipb.pt/#filter=comissoes.pt</a>	Scientific committee
2021	International Seminar Different Approaches to STEM Education <a href="https://eventos.fct.unl.pt/stem_seminar/pages/organizing-committee">https://eventos.fct.unl.pt/stem_seminar/pages/organizing-committee</a>	Organizing Committee
2019	International Seminar PiME – Proof in Mathematics Education <a href="http://hilbert.dm.fct.unl.pt/?page_id=381">http://hilbert.dm.fct.unl.pt/?page_id=381</a>	Chair of Scientific & Organizing Committee

#### PUBLICATIONS IN INDEXED JOURNALS (SELECTED PAPERS FROM THE LAST 5 YEARS)

1. **Rocha**, H., Viseu, F., & Matos, S. (2024). Problem solving in a real-life context: an approach during the learning of inequalities. *European Journal of Science and Mathematics Education*, 12(1), 21-37. <https://doi.org/10.30935/scimath/13828>
2. **Rocha**, H. (2023). The impact of teachers' knowledge on the connection between technology supported exploration and mathematical proof. *European Journal of Science and Mathematics Education*, 11(4), 635-649. <https://doi.org/10.30935/scimath/13285>
3. Martins, R., Viseu, F., & **Rocha**, H. (2023). Functional thinking: a study with 10th grade students. *Education Sciences*, 13(4), 1-22. <https://doi.org/10.3390/educsci13040335>
4. **Rocha**, H. (2023). Analyzing teachers' knowledge based on their approach to the information provided by technology. *European Journal of Science and Mathematics Education*, 11(1), 132-145. <https://doi.org/10.30935/scimath/12522>
5. **Rocha**, H. (2022). Contribution of the analysis of the mathematical concordance to understand the teachers' KTMT. *Journal of Curriculum and Teaching*, 11(8), 412-422. <https://doi.org/10.5430/jct.v11n8p412>
6. Viseu, F., **Rocha**, H., & Monteiro, J. M. (2022). Rethinking digital technology versus paper and pencil in the learning of 3D Geometry. *Journal of Learning for Development*, 9(2), 267-278. <https://doi.org/10.56059/jl4d.v9i2.645>
7. Viseu, F., Silva, A., **Rocha**, H., & Mendes, P. (2022). The graphical representation in the learning of functions by 10th grade students. *Educación Matemática*, 34(1), 186-213. <https://doi.org/10.24844/EM3401.07>
8. **Rocha**, H. (2021). Mathematical knowledge for teaching with technology: episodes of one teacher's practice. *Educação Matemática Debate*, 5(11), 1-22. <https://doi.org/10.46551/emd.e202125>
9. **Rocha**, H. (2020). Using tasks to develop pre-service teachers' knowledge for teaching mathematics with digital technology. *ZDM Mathematics Education*, 52(7), 1381-1396. <https://doi.org/10.1007/s11858-020-01195-1>
10. **Rocha**, H. (2020). Graphical representation of functions using technology: a window to teacher knowledge. *Teaching Mathematics and its Applications*, 39(2), 105-126. <https://doi.org/10.1093/teamat/hrz011>
11. **Rocha**, H. & Oitavem, I. (2019). Barcodes: The mathematics of everyday life. *The Scottish Mathematical Council Journal*, 49, 33-37. <https://novaresearch.unl.pt/en/publications/barcodes-the-mathematics-of-everyday-life>
12. **Rocha**, H. (2019). Mathematical proof: from mathematics to school mathematics. *Philosophical Transactions of the Royal Society A*, 377(2140), 1-12. <https://doi.org/10.1098/rsta.2018.0045>

#### PRIZES AND AWARDS

Scientific publication award CICS.NOVA 2021 (for the journal paper n.º 9).