ChoiCo, SorBET, MaLT2: Building Computational Thinking Experiences

Building Computational Thinking Experiences With Digital Authoring Tools in Interdisciplinary Contexts

Chronis Kynigos[1], Marianthi Grizioti[1], Myrto Karavakou[1], Maria-Stella Nikolaou[1], Christina Gkreka[1], and Charikleia Korompli[1]

[1] Educational Technology Lab, National and Kapodistrian University of Athens, Athens, Greece

Abstract

This workshop addresses the pressing need to broaden computational thinking (CT) beyond traditional coding exercises by integrating digital authoring tools into diverse, culturally relevant and interdisciplinary activities. In today's rapidly evolving educational landscape, CT is recognised as a vital 21st-century literacy; yet its implementation has often been confined to isolated programming contexts. The workshop offers a series of hands-on activities rooted in constructionist learning principles and based on recent insights from the fields of embodied cognition, game-based learning, and data science. Utilizing three innovative tools – 1. ChoiCo, which enables the modification of socio-scientific simulation games; 2. SorBET, which supports the design of classification games; and 3. MaLT2, which facilitates the creation of 3D animations that merge artistic expression with mathematical modeling – the workshop aims at bridging theory and practice. It not only demonstrates practical applications of these tools in lesson planning, but also provokes deeper discussion about their underlying theoretical foundations. By outlining concrete strategies for classroom integration, the workshop addresses the needs of diverse learner groups, from novice students to educators seeking innovative instructional techniques. Ultimately, it aims to extend current CT research by exploring its interdisciplinary applications and equipping practitioners with adoptable tools and methodologies, thereby linking CT with data science, mathematical modeling, creative-artistic expression, and critical thinking on socio-scientific, cultural, and ethical issues.

Keywords and Phrases: Computational Thinking, Constructionism, Game-based Learning, Digital Authoring Tools

Workshop Description: scope, motivationa and background

In an era where computational thinking (CT) is increasingly seen as a foundational literacy for the 21st century, there remains a critical need to be extended beyond the confines of traditional coding exercises (Wing, 2006; Yadav et al., 2016). This workshop is designed to address that gap by integrating digital authoring tools into interdisciplinary activities, thereby broadening the scope and applicability of CT.

Kynigos, C., Grizioti, M., Karavakou, M., Nikolaou, M.S., Gkreka, C., & Korompli, C. (2025). ChoiCo, SorBET, MaLT2. Building Computational Thinking Experiences With Digital Authoring Tools in Interdisciplinary Contexts. *Constructionism Conference Proceedings, 8/2025*, 569–571. https://doi.org/10.21240/constr/2025/61.X

One of its central premise is that CT skills can be nurtured along with creativity, problem solving and critical thinking across a wide range of contexts and practices that are important and meaningful for the students (Grizioti, 2025; Kynigos & Grizioti, 2020). The workshop is structured to support a diverse range of students, from students with little to no prior experience in programming, to experienced educators and researchers seeking innovative practices. Our approach is deeply rooted in constructionist learning theory, that emphasizes the learner's active role in meaning making through creating and tinkering personally meaningful artefacts (Kynigos, 2015; Papert, 1980). We also draw on insights from embodied cognition, game-based learning and data science to create a multifaceted educational experience through using three distinct online tools:

1. ChoiCo (Choices with Consequences) (http://etl.ppp.uoa.gr/choico/) is a game authoring environment designed to support an integrated approach to CT through game modding (Kynigos & Grizioti, 2020). It enables participants to play, design or modify socio-scientific scenarios embedded within a digital game framework. In ChoiCo games, the player can make choices among the available points displayed on the screen, keeping in mind that each choice corresponds to specific consequences that are numerically reflected in the score of the game. ChoiCo challenges students to identify, question, and modify problematic rules or parameter values, thereby promoting a deeper understanding of abstraction, generalization, and debugging processes. This modding activity encourages students to transition from mere game players to critical evaluators and designers, constructing and transferring meaning across different computational representations while addressing real-world issues, such as sustainability, within a familiar and engaging context (Kynigos & Grizioti, 2020; Brennan & Resnick, 2012).
2. SorBET (Sorting Based on Educational Technology) (http://etl.ppp.uoa.gr/sorbet/) uniquely blends coding, database design and gameplay to cultivate CT and data literacy through the lens of classification as inquiry. Learners play, design, and modify sorting games where falling objects must be "pushed" into dynamically defined category boxes. Unlike traditional classification tasks, SorBET foregrounds the subjectivity of categorization: users must interrogate what makes something classifiable -questioning criteria, revising labels and debating boundary cases (Grizioti & Kynigos, 2024). By iteratively refining data models, learners engage in core CT practices, like abstraction and pattern recognition while confronting real-world complexities. SorBET's design intentionally blurs "correct" answers to foster metacognitive debate, making it equally valuable for students exploring data science fundamentals and educators designing critical thinking activities (Grizioti & Nikolaou, 2023).
3. MaLT2 (Machine Lab Turtle-sphere) (http://etl.ppp.uoa.gr/malt2/) extends traditional Logo programming into a richly layered 3D space, fusing CT with mathematical and artistic experiences. Grounded in constructionist principles, MaLT2 enables students to create, manipulate, and animate 3D geometrical models through textual programming, combined with dynamic manipulation tools, such as parameter sliders and periscopic camera navigation (Kynigos & Grizioti, 2018). This integrated approach not only reinforces core programming skills, like decomposition, abstraction and algorithm design, but also deepens students' understanding of mathematical concepts, such as functions-covariation and geometric-spatial transformations (Gkreka & Kynigos, 2025; Karavakou et al., 2023). In addition, MaLT2 can serve as a bridge between mathematics and art, inviting

students to explore the expressive potential of mathematics in a manner that is engaging, personally meaningful and connected to authentic sensory, embodied and aesthetic experiences (Karavakou et al., 2023).

Acknowledgements

Part of this study is funded by the HORIZON-WIDERA project of the European Research Executive Agency (REA): TransEET (Transforming Education with Emerging Technologies) (project no: 101078875) and part of it by E.U. Horizon Europe Framework Programme for Research and Innovation "Exten.D.T.2 – Extending Design Thinking with Emerging Digital Technologies" (Project No. 101060231). The European Union's support for the production of this paper does not constitute an endorsement of the contents, which reflect the views only of the authors.

References

Brennan, K., & Resnick, M. (2012). New frameworks for studying and assessing the development of computational thinking. In Proceedings of the 2012 annual meeting of the American Educational Research Association, Vancouver, Canada. 1–25.

Gkreka, C., & Kynigos, C. (2025). Spatial thinking with dynamically linked digital and embodied representations. International Research in Geographical and Environmental Education, 1-20. https://doi.org/10.1080/10382046.2025.2473706

Grizioti, M. (2025). Computational thinking beyond coding: exploring student computational practices while playing and modifying a socio-scientific simulation game with integrated computational tools. Educational technology research and development, 1-28. https://doi.org/10.1007/s11423-025-10477-y

Grizioti, M., & Kynigos, C. (2024). Integrating computational thinking and data science: The case of modding classification games. Informatics in Education, 23(1), 101-124. https://doi.org/10.15388/infedu.2024.03

Grizioti, M., & Nikolaou, M. S. (2023). ENHANCING STUDENTS'21 ST CENTURY SKILLS THROUGH PLAYING AND MODIFYING EMBODIED DIGITAL CLASSIFICATION GAMES. In 16th International Conference on Technology in Mathematics Teaching (p. 61).

Karavakou, M., Kynigos, C., & Sinclair, N. (2023). Bridging disciplinary aesthetics: when Mathematics meets Art through Educational Technology. In Frontiers in Education (Vol. 8, p. 1284718). Frontiers. https://doi.org/10.3389/feduc.2023.1284718

Kynigos, C. (2015). Constructionism: Theory of learning or theory of design? In S. J. Cho (Ed.), Selected Regular Lectures from the 12th International Congress on Mathematical Education (pp. 417–438). Cham, Switzerland: Springer International Publishing.

Kynigos, C., & Grizioti, M. (2018). Programming approaches to computational thinking: Integrating turtle geometry, dynamic manipulation and 3D space. Informatics in Education, 17(2), 321-340.

Kynigos, C., & Grizioti, M. (2020). Modifying games with ChoiCo: Integrated affordances and engineered bugs for computational thinking. British journal of educational technology, 51(6), 2252-2267. https://doi.org/10.1111/bjet.12898

Papert, S. (1980). Mindstorms: Children, computers, and powerful ideas. New York, NY: Basic Books Inc.

Wing, J. M. (2006). Computational thinking. Communications of the ACM, 49(3), 33-35. https://doi.org/10.1145/1118178.1118215

Yadav, A., Hong, H., & Stephenson, C. (2016). Computational Thinking for All: Pedagogical Approaches to Embedding 21st Century Problem Solving in K–12 Classrooms. TECHTRENDS, 60(6), 565–568. https://doi.org/10.1007/s11528-016-0087-7