## "Digital Game-Based Learning in Primary School: what issues does / does not recent research focus on?"

A systematic literature review of recent (2017-2020) research

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## List of the 87 selected and coded papers

- [1]. Aljojo, N. (2018). The Design and Implementation of a Mathematics Game-Base Learning Application for Primary Students. International Journal of Interactive Mobile Technologies, 12(3), 142. https://doi.org/10.3991/ijim.v12i3.8739
- [2]. Azid, N. H., Yusoff, H. N., Bin Ishak, M. Z., & Ali, N. B. M. (2019). The Creation of Technological Interactive Cerdik BM Series 1 as an Innovation of Pedagogical Tool to Support Malay Language Skills. International Journal of Innovative Technology and Exploring Engineering, 8(12), 33–42. https://doi.org/10.35940/ijitee.l2486.1081219
- [3]. Baek, Y., & Touati, A. (2019). Comparing Collaborative and Cooperative Gameplay for Academic and Gaming Achievements. Journal of Educational Computing Research, 57(8), 2110–2140. https://doi.org/10.1177/0735633118825385
- [4]. Beserra, V., Nussbaum, M., & Grass, A. (2017). Using a fine-grained multiple-choice response format in educational drill-and-practice video games. Interactive Learning Environments, 25(6), 717-732.
- [5]. Brezovszky, B., McMullen, J., Veermans, K., Hannula-Sormunen, M. M., Rodríguez-Aflecht, G., Pongsakdi, N., Laakkonen, E., & Lehtinen, E. (2019). Effects of a mathematics game-based learning environment on primary school students' adaptive number knowledge. Computers & Education, 128, 63–74. https://doi.org/10.1016/j.compedu.2018.09.011
- [6]. Broza, O., & Kolikant, Y. B. D. (2020). The Potential of Rich Digital Game-Based Learning Environments to Promote Low-Achieving Students' Participation in Mathematics. International Journal of Game-Based Learning, 10(4), 40-54. https://doi.org/10.4018/ijgbl.2020100103
- [7]. Bui, P., Rodríguez-Aflecht, G., Brezovszky, B., Hannula-Sormunen, M. M., Laato, S., & Lehtinen, E. (2020). Understanding students' game experiences throughout the developmental process of the number navigation game. Educational Technology Research and Development, 68(5), 2395–2421. https://doi.org/10.1007/s11423-020-09755-8
- [8]. Che Ku Nuraini, C. K. N., Shahbodin, F., Sedek, M., & Samsudin, M. (2020). Game based learning for autism in learning mathematics. International Journal of Advanced Science and Technology, 29(5), 4684-4691.
- [9]. Chen, M.-B., Wang, S.-G., Chen, Y.-N., Chen, X.-F., & Lin, Y.-Z. (2020). A Preliminary Study of the Influence of Game Types on the Learning Interests of Primary School Students in Digital Games. Education Sciences, 10(4), 96.

https://doi.org/10.3390/educsci10040096

- [10]. Chen, M.-H. M., Tsai, S.-T., & Chang, C.-C. (2019). Effects of Game-Based Instruction on the Results of Primary School Children Taking a Natural Science Course. Education Sciences, 9(2), 79. https://doi.org/10.3390/educsci9020079
- [11]. Chou, P.-N., Chang, C.-C., & Hsieh, S.-W. (2020). Connecting digital elements with physical learning contexts: an educational escape-the-room game for supporting learning in young children. Technology, Pedagogy and Education, 29(4), 425–444.
  https://doi.org/10.1080/1475939x.2020.1775694
- [12]. Chu, H. C., Wang, C. C., & Wang, L. (2019). Impacts of concept map-based collaborative mobile gaming on english grammar learning performance and behaviors. Journal of Educational Technology & Society, 22(2), 86-100.
- [13]. Cui, Y., Chu, M. W., & Chen, F. (2019). Analyzing Student Process Data in Game-Based Assessments with Bayesian Knowledge Tracing and Dynamic Bayesian Networks. Journal of Educational Data Mining, 11(1), 80-100.
- [14]. Del Moral Pérez, M. E., Guzmán Duque, A. P., & Fernández García, L. C. (2018). Game-Based Learning: Increasing the Logical-Mathematical, Naturalistic, and Linguistic Learning Levels of Primary School Students. Journal of New Approaches in Educational Research, 7(1), 31–39. https://doi.org/10.7821/naer.2018.1.248
- [15]. Deng, L., Wu, S., Chen, Y., & Peng, Z. (2020). Digital game-based learning in a Shanghai primary-school mathematics class: A case study. Journal of Computer Assisted Learning, 36(5), 709–717. https://doi.org/10.1111/jcal.12438
- [16]. Duncan, K. J. (2020). Examining the Effects of Immersive Game-Based Learning on Student Engagement and the Development of Collaboration, Communication, Creativity and Critical Thinking. TechTrends, 64(3), 514–524.
  https://doi.org/10.1007/s11528-020-00500-9
- [17]. El Mawas, N., Tal, I., Moldovan, A.-N., Bogusevschi, D., Andrews, J., Muntean, G.-M., & Muntean, C. H.
  (2020). Investigating the impact of an adventure-based 3D solar system game on primary school learning process. Knowledge Management & E-Learning: An International Journal, 12(2), 165–190. https://doi.org/10.34105/j.kmel.2020.12.009
- [18]. Ellison, M., & Drew, C. (2019). Using Digital Sandbox Gaming to Improve Creativity Within Boys' Writing. Journal of Research in Childhood Education, 34(2), 277–287. https://doi.org/10.1080/02568543.2019.1675823
- [19]. Fokides, E. (2017). Digital educational games and mathematics. Results of a case study in primary school settings. Education and Information Technologies, 23(2), 851–867.
  https://doi.org/10.1007/s10639-017-9639-5
- [20]. Fokides, E., & Foka, A. (2017). Computer Games and English as a Foreign Language: Results of a Pilot Study. Open Journal for Educational Research, 1(1), 31–44. https://doi.org/10.32591/coas.ojer.0101.03031f
- [21]. Georgiou, Y., Ioannou, A., & Ioannou, M. (2019). Investigating Immersion and Learning in a Low-Embodied versus High-Embodied Digital Educational Game: Lessons Learned from an Implementation in an Authentic School Classroom. Multimodal Technologies and Interaction, 3(4), 68. https://doi.org/10.3390/mti3040068

- [22]. Godfrey, Z., & Mtebe, J. (2018). Redesigning Local Games to Stimulate Pupils' Interest in Learning Numeracy in Tanzania. International Journal of Education and Development Using Information and Communication Technology, 14(3), 17-37.
- [23]. Hainey, T., Baxter, G., & Ford, A. (2019). An evaluation of the introduction of games-based construction learning in upper primary education using a developed game codification scheme for scratch. Journal of Applied Research in Higher Education, 12(3), 377–402. https://doi.org/10.1108/jarhe-02-2018-0031
- [24]. Hautala, J., Heikkilä, R., Nieminen, L., Rantanen, V., Latvala, J.-M., & Richardson, U. (2020). Identification of Reading Difficulties by a Digital Game-Based Assessment Technology. Journal of Educational Computing Research, 58(5), 1003–1028. https://doi.org/10.1177/0735633120905309
- [25]. Hong, J.-C., Hwang, M.-Y., Tai, K.-H., Lin, P.-H., & Lin, P.-C. (2019). Learning Progress in a Chinese Order of Stroke Game: The Effects of Intrinsic Cognitive Load and Gameplay Interest Mediated by Flow Experience. Journal of Educational Computing Research, 58(4), 842–862. https://doi.org/10.1177/0735633119881471
- Hooshyar, D., Pedaste, M., Yang, Y., Malva, L., Hwang, G.-J., Wang, M., Lim, H., & Delev, D. (2020). From Gaming to Computational Thinking: An Adaptive Educational Computer Game-Based Learning Approach. Journal of Educational Computing Research, 073563312096591. https://doi.org/10.1177/0735633120965919
- [27]. Hughes-Roberts, T., Brown, D., Boulton, H., Burton, A., Shopland, N., & Martinovs, D. (2020). Examining the potential impact of digital game making in curricula based teaching: Initial observations. Computers & Education, 158, 103988. https://doi.org/10.1016/j.compedu.2020.103988
- Hulse, T., Daigle, M., Manzo, D., Braith, L., Harrison, A., & Ottmar, E. (2019). From here to there!
  Elementary: a game-based approach to developing number sense and early algebraic understanding.
  Educational Technology Research and Development, 67(2), 423–441.
  https://doi.org/10.1007/s11423-019-09653-8
- [29]. Hwa, S. P. (2018). Pedagogical change in mathematics learning: Harnessing the power of digital gamebased learning. Journal of Educational Technology & Society, 21(4), 259-276.
- [30]. Imlig-Iten, N., & Petko, D. (2018). Comparing Serious Games and Educational Simulations: Effects on Enjoyment, Deep Thinking, Interest and Cognitive Learning Gains. Simulation & Gaming, 49(4), 401–422. https://doi.org/10.1177/1046878118779088
- [31]. Ioannou, A. (2018). A model of gameful design for learning using interactive tabletops: enactment and evaluation in the socio-emotional education classroom. Educational Technology Research and Development, 67(2), 277–302.
  https://doi.org/10.1007/s11423-018-9610-1
- [32]. Israel-Fishelson, R., & Hershkovitz, A. (2019). Persistence in a Game-Based Learning Environment: The Case of Elementary School Students Learning Computational Thinking. Journal of Educational Computing Research, 58(5), 891–918. https://doi.org/10.1177/0735633119887187

- [33]. Jarvoll, A. B. (2018). "I'll have everything in diamonds!": students' experiences with minecraft at school.
  Studia Paedagogica, 4, 67-89.
  https://doi.org/10.5817/sp2018-4-4
- [34]. Jay, T., Habgood, J. M. P., Mees, M., & Howard-Jones, P. (2019). Game-based training to promote arithmetic fluency. Frontiers in Education, 4, 118. https://doi.org/10.3389/feduc.2019.00118
- [35]. Johann, V. E., & Karbach, J. (2019). Effects of game-based and standard executive control training on cognitive and academic abilities in elementary school children. Developmental Science, 23(4),. https://doi.org/10.1111/desc.12866
- [36]. Jones, C., Scholes, L., Rolfe, B., & Stieler-Hunt, C. (2020). A serious-game for child sexual abuse prevention: An evaluation of Orbit. Child Abuse & Neglect, 107, 104569. https://doi.org/10.1016/j.chiabu.2020.104569
- [37]. Khamparia, A., Pandey, B., & Mishra, B. P. (2020). Effects of microworld game-based approach on neuromuscular disabled students learning performance in elementary basic science courses. Education and Information Technologies, 25(5), 3881–3896. https://doi.org/10.1007/s10639-020-10142-2
- [38]. Kim, H., & Ke, F. (2017). Effects of game-based learning in an OpenSim-supported virtual environment on mathematical performance. Interactive Learning. Environments, 25(4), 543-557.
- [39]. Kim, H., Ke, F., & Paek, I. (2017). Game-based learning in an OpenSim-supported virtual environment on perceived motivational quality of learning. Technology, Pedagogy and Education, 26(5), 617–631. https://doi.org/10.1080/1475939x.2017.1308267
- [40]. Lee, H. K., & Choi, A. (2020). Enhancing early numeracy skills with a tablet-based math game intervention: a study in Tanzania. Educational Technology Research and Development, 68(6), 3567–3585. https://doi.org/10.1007/s11423-020-09808-y
- [41]. Leonardou, A., Rigou, M., & Garofalakis, J. (2020). Techniques to Motivate Learner Improvement in Game-Based Assessment. Information, 11(4), 176. https://doi.org/10.3390/info11040176
- [42]. Liao, C. C. Y., Chang, W.-C., & Chan, T.-W. (2018). The effects of participation, performance, and interest in a game-based writing environment. Journal of Computer Assisted Learning, 34(3), 211–222. https://doi.org/10.1111/jcal.12233
- [43]. Lin, Y. T., Tseng, Y. M., Lee, Y. S., Wang, T. C., Tsai, S. I., & Yi, Y. J. (2018). Development of a SoLoMo gamebased application for supporting local cultural learning in Taiwan. Journal of Educational Technology & Society, 21(4), 115-128.
- [44]. Lin, Y.-C., Hsieh, Y.-H., Hou, H.-T., & Wang, S.-M. (2019). Exploring students' learning and gaming performance as well as attention through a drill-based gaming experience for environmental education. Journal of Computers in Education, 6(3), 315–334. https://doi.org/10.1007/s40692-019-00130-y
- [45]. Liu, Z.-Y., Shaikh, Z. A., & Gazizova, F. (2020). Using the Concept of Game-Based Learning in Education. International Journal of Emerging Technologies in Learning, 15(14), 53. https://doi.org/10.3991/ijet.v15i14.14675

- [46]. Lu, S.-J., Liu, Y.-C., Chen, P.-J., & Hsieh, M.-R. (2018). Evaluation of AR embedded physical puzzle game on students' learning achievement and motivation on elementary natural science. Interactive Learning Environments, 28(4), 451–463. https://doi.org/10.1080/10494820.2018.1541908
- [47]. Lu, Y.-L., & Lien, C.-J. (2019). Are They Learning or Playing? Students' Perception Traits and Their Learning Self-Efficacy in a Game-Based Learning Environment. Journal of Educational Computing Research, 57(8), 1879–1909. https://doi.org/10.1177/0735633118820684
- [48]. Mohd Rashid, N. A. B., Md Salleh, S. B., & Md Noor, N. B. (2019). Development of Jawi Spelling Skills
  Mobile Applications, 'Oh Jawiku'. International Journal of Interactive Mobile Technologies, 13(07), 80–89. https://doi.org/10.3991/ijim.v13i07.1075
- [49]. Mossmann, J. B., Cerqueira, B. B., Barbosa, D. N., Fonseca, R. P., & Reategui, E. B. (2019). The Planning of Difficulty Curves in an Exergame for Inhibitory Control stimulation in a school intervention program: a pilot study. Frontiers in psychology, 10, 2271. https://doi.org/10.3389/fpsyg.2019.02271
- [50]. Näykki, P., Laru, J., Vuopala, E., Siklander, P., & Järvelä, S. (2019). Affective learning in digital education case studies of social networking systems, games for learning, and digital fabrication. Frontiers in Education, 4, 128.
- [51]. O'Rourke, J., Main, S., & Hill, S. M. (2017). Commercially available Digital Game Technology in the Classroom: Improving Automaticity in Mental-maths in Primary-aged Students. Australian Journal of Teacher Education, 42(10), 50-70.
- [52]. Partovi, T., & Razavi, M. R. (2019). The effect of game-based learning on academic achievement motivation of elementary school students. Learning and Motivation, 68, 101592. https://doi.org/10.1016/j.lmot.2019.101592
- [53]. Piñero Charlo, J. C. (2020). Educational Escape Rooms as a Tool for Horizontal Mathematization: Learning Process Evidence. Education Sciences, 10(9), 213. https://doi.org/10.3390/educsci10090213
- [54]. Rahayu, G. D. S., & Arga, H. S. P. (2019). Influence of VBA-based Monopoly Game in Microsoft Excel as Teaching Material on Primary School Students' Cross-Cultural Competence in Social Studies Learning. Mimbar Sekolah Dasar, 6(2), 147. https://doi.org/10.17509/mimbar-sd.v6i2.16935
- [55]. Ramos, D. K., & Melo, H. M. (2018). Can digital games in school improve attention? A study of Brazilian elementary school students. Journal of Computers in Education, 6(1), 5–19. https://doi.org/10.1007/s40692-018-0111-3
- [56]. Ribeiro, M. D. C. (2019). Analog and Digital Games as a Pedagogical Tool in the Teacher Training Context. Research in Social Sciences and Technology, 4(2), 163–173. https://doi.org/10.46303/ressat.04.02.12
- [57]. Ronimus, M., Eklund, K., Pesu, L., & Lyytinen, H. (2019). Supporting struggling readers with digital gamebased learning. Educational Technology Research and Development, 67(3), 639–663. https://doi.org/10.1007/s11423-019-09658-3

- [58]. Rose, S. P., Habgood, M. P. J., Jay, T. (2020). Designing a Programming Game to Improve Children's Procedural Abstraction Skills in Scratch. Journal of Educational Computing Research, 58(7), 1372–1411. https://doi.org/10.1177/0735633120932871
- [59]. Sabirli, Z. E., & Coklar, A. N. (2020). The Effect of Educational Digital Games on Education, Motivation and Attitudes of Elementary School Students against Course Access. World Journal on Educational Technology: Current Issues, 12(3), 165-178.
- [60]. Soni, M., & Okamoto, Y. (2020). Improving children's fraction understanding through the use of number lines. Mathematical Thinking and Learning, 3, 233–243. https://doi.org/10.1080/10986065.2020.1709254
- [61]. Strawhacker, A., Sullivan, A., Verish, C., Umashi Bers, M., & Shaer, O. (2018). Enhancing Children's Interest and Knowledge in Bioengineering through an Interactive Videogame. Journal of Information Technology Education: Innovations in Practice, 17, 055–081. https://doi.org/10.28945/3976
- [62]. Stylianidou, N., Sofianidis, A., Manoli, E., & Meletiou-Mavrotheris, M. (2020). "Helping Nemo!"—Using Augmented Reality and Alternate Reality Games in the Context of Universal Design for Learning.
  Education Sciences, 10(4), 95. https://doi.org/10.3390/educsci10040095
- [63]. Sun, J. C. Y., Kuo, C. Y., Hou, H. T., & Lin, Y. Y. (2017). Exploring learners' sequential behavioral patterns, flow experience, and learning performance in an anti-phishing educational game. Journal of Educational Technology & Society, 20(1), 45-60.
- [64]. Sun, L., Ruokamo, H., Siklander, P., Li, B., & Devlin, K. (2021). Primary school students' perceptions of scaffolding in digital game-based learning in mathematics. Learning, Culture and Social Interaction, 28, 100457.
  https://doi.org/10.1016/j.lcsi.2020.100457
- [65]. Sung, H. Y., Hwang, G. J., Lin, C. J., & Hong, T. W. (2017). Experiencing the Analects of Confucius: An experiential game-based learning approach to promoting students' motivation and conception of learning. Computers & Education, 110, 143-153.
- [66]. Sung, H. Y., Hwang, G. J., Wu, P. H., & Lin, D. Q. (2018). Facilitating deep-strategy behaviors and positive learning performances in science inquiry activities with a 3D experiential gaming approach. Interactive Learning Environments, 26(8), 1053-1073.
- [67]. Tazouti, Y., Boulaknadel, S., & Fakhri, Y. (2019). JeuTICE: An Arabic Serious Game to Enhance Mathematics Skills of Young Children. International Journal of Emerging Technologies in Learning, 14(22), 252. https://doi.org/10.3991/ijet.v14i22.11119
- [68]. Touati, A., & Baek, Y. (2017). What Leads to Player's Enjoyment and Achievement in a Mobile Learning Game? Journal of Educational Computing Research, 56(3), 344–368. https://doi.org/10.1177/0735633117713022
- [69]. Towers, B., & Whybro, M. (2018). A formative evaluation of the triple zero kids challenge teacher's guide. The Australian Journal of Emergency Management, 33(3), 64.
- [70]. Tsai, C. -. Y., Lin, H. -., & Liu, S. -. C. (2019). The effect of pedagogical GAME model on students' PISA scientific competencies. Journal of Computer Assisted Learning, 36(3), 359–369. https://doi.org/10.1111/jcal.12406

- [71]. Wang, S.-Y., Chang, S.-C., Hwang, G.-J., & Chen, P.-Y. (2017). A microworld-based role-playing game development approach to engaging students in interactive, enjoyable, and effective mathematics learning. Interactive Learning Environments, 26(3), 411–423. https://doi.org/10.1080/10494820.2017.1337038
- [72]. Wang, Y. H. (2020). Integrating Games, e-Books and AR Techniques to Support Project-based Science Learning. Educational Technology & Society, 23(3), 53-67. https://www.jstor.org/stable/26926426
- [73]. Ward, M., Mozgovoy, M., & Purgina, M. (2019). Can WordBricks Make Learning Irish More Engaging for Students? International Journal of Game-Based Learning, 9(2), 20–39. https://doi.org/10.4018/ijgbl.2019040102
- [74]. Yalipep M., & Kutlu, B. (2019). Mobile serious games: Effects on students' understanding of programming concepts and attitudes towards information technology. Education and Information Technologies, 25(2), 1237–1254. https://doi.org/10.1007/s10639-019-10008-2
- [75]. Yang, J. C., & Chen, S. Y. (2020). An investigation of game behavior in the context of digital game-based learning: An individual difference perspective. Computers in Human Behavior, 112, 106432. https://doi.org/10.1016/j.chb.2020.106432
- [76]. Yang, J. C., & Quadir, B. (2018a). Effects of prior knowledge on learning performance and anxiety in an English learning online role-playing game. Journal of Educational Technology & Society, 21(3), 174-185.
- [77]. Yang, J. C., & Quadir, B. (2018b). Individual differences in an English learning achievement system: gaming flow experience, gender differences and learning motivation. Technology, Pedagogy and Education, 27(3), 351–366.

https://doi.org/10.1080/1475939x.2018.1460618

- [78]. Yang, J. C., Lin, M. Y. D., & Chen, S. Y. (2018). Effects of anxiety levels on learning performance and gaming performance in digital game-based learning. Journal of Computer Assisted Learning, 34(3), 324–334. https://doi.org/10.1111/jcal.12245
- Yang, J. C., Quadir, B., & Chen, N.-S. (2018). Effects of Children's Trait Emotional Intelligence on Digital Game-Based Learning. International Journal of Human–Computer Interaction, 35(4–5), 374–383. https://doi.org/10.1080/10447318.2018.1543088
- [80]. Yang, K. H. (2017). Learning behavior and achievement analysis of a digital game-based learning approach integrating mastery learning theory and different feedback models. Interactive Learning Environments, 25(2), 235-248.
- [81]. Yeh, C. Y. C., Cheng, H. N. H., Chen, Z.-H., Liao, C. C. Y., & Chan, T.-W. (2019). Enhancing achievement and interest in mathematics learning through Math-Island. Research and Practice in Technology Enhanced Learning, 14(1), 1–2. https://doi.org/10.1186/s41039-019-0100-9
- [82]. Yeh, Y.-, & Lin, C. S. (2018). Achievement goals influence mastery experience via two paths in digital creativity games among elementary school students. Journal of Computer Assisted Learning, 34(3), 223–232.
  https://doi.org/10.1111/jop112224

https://doi.org/10.1111/jcal.12234

[83]. Yeh, Y.-, Chang, H.-L., & Chen, S.-Y. (2019). Mindful learning: A mediator of mastery experience during digital creativity game-based learning among elementary school students. Computers & Education, 132, 63–75.

https://doi.org/10.1016/j.compedu.2019.01.001

- [84]. Yoon, J. H., & Kim, J. Y. (2019). Design and implementation of invention learning curriculum-based serious game contents. New Review of Hypermedia and Multimedia, 25(3), 205–221. https://doi.org/10.1080/13614568.2019.1645216
- [85]. Yunus, M. Md., Yen, E. L. Y., Hartini Mohd Khair, A., & Mohd Yusof, N. (2020). Acquisition of Vocabulary in Primary Schools Via GoPic with QR Code. International Journal of English Language and Literature Studies, 9(3), 121–131. https://doi.org/10.18488/journal.23.2020.93.121.131
- [86]. Yussop, Y., Annamala, S., & Salam, S. (2019). Hi-Math Mobile App: Effectiveness in Improving Arithmetic Skills of Primary School Students. International Journal of Recent Technology and Engineering (IJRTE), 7(6S2), 1–5.
- [87]. Zare, M., Amani, M., & Sadoughi, M. (2019). The role of Persian-language word exercise games in improving spelling of students with dyslexia: Word exercise games in improving spelling. Journal of Computer Assisted Learning, 36(3), 315–322. https://doi.org/10.1111/jcal.12400