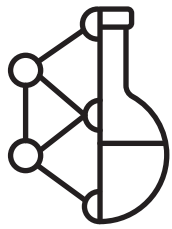
BÖLÜM 12



ERKEN ÇOCUKLUK DÖNEMİ FEN EĞİTİMİNDE ALGORİTMİK DÜŞÜNME EĞİTİMİ

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GİRİŞ

21. yüzyılda insanlar teknolojinin hem tüketicisi olmak hem de onları üretmekle ilgilenmektedir. Geçmiş dönemlerde ki çocuklardan farklı olarak günümüzde çocuklar dijital yerliler olarak yetişmektedir. Ancak, insanları teknolojinin son kullanıcısı olarak büyümemeleri için onları yönlendirmek ve mümkün olan en kısa sürede bilgi işlemsel düşünme becerilerinin geliştirilmesi gerekmektedir. Bilgi işlemsel düşünmenin geliştirilmesi, geleceğin bilim insanlarını veya mühendislerini yetiştirmek için gereklidir. Aynı zamanda birçok bilişsel ve entelektüel beceriyi geliştirerek insanların gerçek sorunları çözmelerine de olanak sağlayabileceği düşünülmektedir. Örneğin, "evinden markete giden en iyi yolu bulmak" ya da "bir nesnenin yörüngesini hesaplamak" gibi. Son yıllarda, bilgi işlemsel düşünme çeşitli eğitim bağlamlarında eğitimciler ve araştırmacılar tarafından büyük bir ilgi görmektedir (1-3). Algoritmik düşünme gibi bilgisayar bilimlerindeki kavramlardan yararlanan bilgi işlemsel düşünme, gerçek dünyadaki problemleri ele almanın ve bunları çözmenin bir yolu olarak kullanılmaktadır (4). Şüphesiz bilgi işlemsel düşünme, programcılar ve bilgisayar bilimi alanındaki insanlar için çok önemlidir. Günümüzde bilgisayarların yaygın olarak kullanılmasıyla birlikte bilgi işlemsel

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problem çözme becerileri güçlendirecektir. Öğrencilerin kendi tutkularına dayalı, akranlarıyla işbirliği içinde, eğlenceli bir ruhla projeler yaratma fırsatlarına dahil olabilmeleri için pedagojiye güçlü bir yatırım yapılması gerekmektedir.

KAYNAKLAR

1. Hsu TC, Chang SC, Hung YT. How to learn and how to teach computational thinking: Suggestions based on a review of the literature. *Computers & Education.*2018;126: s. 296–310.
2. Grover S, Pea R. Computational thinking in K-12: A review of the state of the field. *Educational Researcher.* 2013;42(1);38–43.
3. Shute VJ, Sun C, Asbell-Clarke J. Demystifying computational thinking. *Educational Research Review.* 2017;22: s.142–158.
4. Buitrago Flo´rez F, Casallas R, Herna´ndez M, et al. Changing a generation's way of thinking: Teaching computational thinking through programming. *Review of Educational Research.* 2017;87(4): s. 834–860.
5. Chen G, Shen J, Barth-Cohen L, et al. Assessing elementary students' computational thinking in everyday reasoning and robotics programming. *Computers & Education.*2017;109: s.162–175.
6. Wing J. Computational thinking. *Communications of the ACM.* 2006;49(3): s.33–35.
7. Karataş H. 21. Yy. Becerilerinden Robotik ve Kodlama Eğitiminin Türkiye ve Dünyadaki Yeri. *21. Yüzyılda Eğitim Ve Toplum Eğitim Bilimleri Ve Sosyal Araştırmalar Dergisi.* 2021;10(30): s.693-729.
8. Lye SY, Koh JHL. Review on teaching and learning of computational thinking through programming: What is next for K-12? *Computers in Human Behavior.*2014;41: s.51–61.
9. Cejka E, Rogers C, Portsmore M. Kindergarten robotics: Using robotics to motivate math, science, and engineering literacy in elementary school. *International Journal of Engineering Education.*2006;22(4): s.711–722.
10. Kazakoff ER, Sullivan A, Bers MU. The effect of a classroom-based intensive robotics and programming workshop on sequencing ability in early childhood. *Early Childhood Education Journal.*2013;41(4): s.245–255.
11. Papert S. *Mindstorms: Children, computers, and powerful ideas*. New York: Basic Books; 1980.
12. Wing J. Research notebook: Computational thinking—What and why. *The link magazine*. 2011;6: s. 20-23.
13. Voogt J, Fisser P, Good, J. et al. Computational thinking in compulsory education: Towards an agenda for research and practice. *Educ Inf Technol.* 2015; 20: s.715–728.
14. Bers MU, González-González C, Armas-Torres MB. Coding as a playground: Promoting positive learning experiences in childhood classrooms. *Computers & Education.* 2019;138: s.130–145.
15. Pugnali A, Sullivan A, Bers MU. The impact of user interface on young children's computational thinking. *Journal of Information Technology Education. Innovations in Practice.* 2017;16: s.171.
16. Relkin E, Ruiter LE, Bers MU. Learning to code and the acquisition of computational thinking by young children. *Computers & Education.* 2021;16: s.104-222.
17. Sung W, Ahn J, Black JB. Introducing computational thinking to young learners: Practicing computational perspectives through embodiment in mathematics education. *Technology, Knowledge and Learning.*2017;22: s.443-463.
18. Wang D, Wang T, Liu Z. A tangible programming tool for children to cultivate computational thinking. *The Scientific World Journal*. 2014.
19. Piaget J. Piaget's theory. In P. Mussen (Ed.) *Carmichael's manual of child psychology,* New York: Wiley, 1970;(1): p.703–832.
20. Weintrop D, Beheshti E, Horn MS. et al. Interactive assessment tools for computational thinking in high school STEM classrooms. In *Intelligent Technologies for Interactive Entertainment: 6th International Conference, INTETAIN 2014, Chicago, IL, USA, July 9-11, 2014. Proceedings 6* (pp. 22-25). Springer International Publishing.
21. Pila S, Aladé F, Sheehan KJ. et al. Learning to code via tablet applications: An evaluation of Daisy

the Dinosaur and Kodable as learning tools for young children. *Computers & Education.* 2019;128: p. 52-62.

22. Bers MU, Flannery L, Kazakoff ER. et al. Computational thinking and tinkering: Exploration of an early childhood robotics curriculum. *Computers & Education.* 2014;72: p.145-157.
23. Papadakis S, Kalogiannakis M, Zaranis N. Developing fundamental programming concepts and computational thinking with ScratchJr in preschool education: a case study. *International Journal of Mobile Learning and Organisation.* 2016;10(3): p.187-202.
24. Critten V, Hagon H, Messer D. Can pre-school children learn programming and coding through guided play activities? A case study in computational thinking. *Early Childhood Education Journal.* 2022;50(6): p.969-981.
25. Tang X, Yin Y, Lin Q, et al. Assessing computational thinking: A systematic review of empirical studies. *Computers & Education*. 2020;148: 103798.
26. Yang W, Ng DTK, Gao H. Robot programming versus block play in early childhood education: Effects on computational thinking, sequencing ability, and self-regulation. *British Journal of Educational Technology.* 2022;53(6): p.1817-1841.
27. Yang W, Luo H, Su J. Towards inclusiveness and sustainability of robot programming in early childhood: Child engagement, learning outcomes and teacher perception. *British Journal of Educational Technology.* 2022;53(6): p.1486-1510.
28. Bers MU. Coding and computational thinking in early childhood: The impact of ScratchJr in Europe. *European Journal of STEM Education.* 2018;3(3):8.
29. Aytekin A, Çakır FS, Yücel YB. et al. Geleceğe yön veren kodlama bilimi ve kodlama öğrenmede kullanılabilecek bazı yöntemler. *Avrasya Sosyal ve Ekonomi Araştırmaları Dergisi.* 2018;5(5): s24-41.
30. Arabacıoğlu T, Bülbül Hİ, Filiz A. Bilgisayar programlama öğretiminde yeni bir yaklaşım. *Akademik bilişim*. 2017: s.193-197.
31. Schneider GM, Gersting JL. *Informatica*. Maggioli Editore. 2013.
32. Gerosa A, Koleszar V, Tejera, G. Cognitive abilities and computational thinking at age 5: Evidence for associations to sequencing and symbolic number comparison. *Computers and Education Open*. 2021;2;100043.
33. Kong SC. A framework of curriculum design for computational thinking development in K-12 education. *Journal of Computers in Education.* 2016;3: p.377-394.
34. Güler Ç. Algorithmic Thinking Skills without Computers for Prospective Computer Science Teachers. *Journal of Theoretical Educational Science. 2021;14*(4): p.570-585.
35. Vujičid L, Jančec L, Mezak J. Development of algorithmic thinking skills in early and preschool education. In L. Gómez Chova, A. López Martínez I, Candel Torres (Eds.), Proceedings of EDULEARN21 Conference (Vol. 5). IATED. 2021: p.8152-8161.
36. Özkan Y. *Programlama dilleri: C ile programlama*. İstanbul: Alfa Yayınları; 2003.
37. Brown W. Introduction to algorithmic thinking. Available at: www.cs4fn.com/ algoritmicthinking. php. [Accessed: July 1st 2023]
38. Futschek G. Algorithmic thinking: the key for understanding computer science. *In International conference on informatics in secondary schools-evolution and perspectives. Berlin* Heidelberg: Springer Berlin Heidelberg. 2006: p.159-168.
39. Cooper S, Dann W, Pausch R. Developing algorithmic thinking with Alice. *In: The proceedings of ISECON 2000* (Vol. 17, pp. 506–539).
40. Rushan Z, Sajid M. Rapidmental computation system as a tool for algorithmic thinking of elementary school students development. *arXiv preprint arXiv:1305.4443, 2013.*
41. Zsakó L, Szlávi P. ICT competences: Algorithmic thinking. *Acta Didactica Napocensia.* 2012;5(2): p.49-58.
42. Bach E, Shallit J. *Algorithmic Number Theory, Vol. I: Efficient Algoritms.* MIT press, 1996.
43. Turan İ, Akça M, Küçükkurt M. *Temel kodlama eğitimi.* İstanbul: Pusula Yayıncılık, 2016.
44. Keşfet Projesi. *Kodlamayı Keşfediyorum Öğretmen Rehberi.* Ankara. https://kesfetprojesi.org/files/uploads/kodlamayi-kesfet-ogretmen-rehberi.pdf [Accessed: 15th July 2023]

45. Kátai Z. The challenge of promoting algorithmic thinking of both sciences-and humanities-oriented learners. *Journal of Computer Assisted Learning.* 2015;31(4): p.287-299.

46. Wing J. Computational thinking's influence on research and education for all. *Italian Journal of Educational Technology.* 2017;25(2): p.7-14.

47. Barr V. Stephenson C. Bringing computational thinking to k-12: what is involved and what is the role of the computer science education community? *ACM Inroads.* 2011;2(1): p.48–54.

48. Bers, M. U. (2020). *Coding as a playground: Programming and computational thinking in the early childhood classroom*. Routledge;2020.

49. Bocconi S, Chioccariello A, Dettori G. et al. *Developing computational thinking in compulsory education-Implications for policy and practice* (No. JRC104188). Joint Research Centre (Seville site). 2016

50. Gomes CA, Gomes H, Rego B. et al. Smart City Kids Lab: Creative Computing in Primary School. *International Symposium on Computers in Education (SIIE), 2019:* p.1-6.

51. Hubalovsky S. Processing of experimental data as educational method of development of algorithmic thinking. *Procedia-Social and Behavioral Sciences*.2015;191: p.1876-1880.

52. Milkova E. Multimedia application for educational purposes: Development of algorithmic thinking. *Applied Computing and Informatics.* 2015;11(1);76-88.

53. Kazakoff ER, Bers MU. Put your robot in, put your robot out: Sequencing through programming robots in early childhood. *Journal of Educational Computing Research.* 2014;50(4): p.553-573.

54. Strawhacker A, Verish C, Shaer O. et. al. Young children's learning of bioengineering with CRISPEE: A developmentally appropriate tangible user interface. *Journal of science education and technology.* 2020;29: p.319-339.

55. Mittermeir RT. Algorithmics for preschoolers—A contradiction?. *Creative Education.* 2013;4(09): p.557.

56. Voronina LV, Sergeeva NN, Utyumova EA. Development of algorithm skills in preschool children. *Procedia-Social and Behavioral Sciences.* 2016;233: p.155-159.

57. Sadykova OV, Il'bahtin GG. The definition of algorithmic thinking. In *International Session on Factors of Regional Extensive Development (FRED 2019).* Atlantis Press; 2020: p. 419-422.

58. Misirli A, Komis V. Robotics and programming concepts in Early Childhood Education: A conceptual framework for designing educational scenarios. In *Research on e-learning and ICT in education: Technological, pedagogical and instructional perspectives*. New York, NY: Springer New York; 2014: p. 99-118.

59. Cittá G, Gentile M, Allegra M. et al. The effects of mental rotation on computational thinking. *Computers & Education.* 2019;141.

60. Martinez C, Gomez MJ, Benotti L. A comparison of preschool and elementary school children learning computer science concepts through a multilanguage robot programming platform. *In Proceedings of the 2015 ACM Conference on Innovation and Technology in Computer Science Education.* Vilnius, Lithuania, 2015: p. 159–164.

61. Muñoz-Repiso AGV, Caballero-González YA. Robotics to develop computational thinking in early childhood education. Comunicar. 2019;27(59): p.63–72.

62. Futschek G. Moschitz J. Developing algorithmic thinking by inventing and playing algorithms. *Proceedings of the Constructionist Approaches to Creative Learning, Thinking Education: Lessons for the 21st Century,* 2010: p.1-10.

63. Vygotsky, L. The genesis of higher mental functions. In J. Wertsch (Ed.), *The concept of activity in Soviet psychology.* Armonk, NY: Sharpe; 1981: p. 144–188.

64. Sullivan A, Bers MU. Investigating the use of robotics to increase girls' interest in engineering during early elementary school. *International Journal of Technology and Design Education*. 2019;29: 1033-1051.

65. Clements DH, Meredith JS. Research on Logo: Effects and efficacy. *Journal of Computing in Childhood Education.* 1993;4(4): p.263-290.

66. Resnick M, Maloney J, Monroy-Hernández A. et al. Scratch: programming for all. *Communications of the ACM.* 2009;52(11): p. 60-67.