Evaluation vs Intervention

	Writing Code	Reading Code	Code Evaluation	Code Explanation	Natural Experiment	Conceptual Enderstanding
Learning/ Grades	17	6	6	12	2	3
Code Quality	8	0	9	5	0	0
Opinion/Perception	19	13	8	15	13	0
Workload	7	1	2	2	0	1
Academic Integrity	5	2	3	3	5	0
Deep Feedback	14	8	6	12	10	0

Population vs Evaluation

	Learning/ Grades	Code Quality	Opinion/ Perception	Workload	Academic Integrity	Deep Feedback
K-12	4	1	1	1	0	1
Undergraduate	23	10	37	7	9	26
First timers	6	3	7	2	0	5
Non CS Students	0	0	3	0	0	2
Educators/Experts	7	1	8	3	7	7
Race	0	0	1	1	0	2
Gender	0	2	2	1	0	3

Population vs Intervention

	Writing Code	Reading Code	Code Evaluation	Code Explanation	Natural Experiment	Conceptual Understanding
K-12	2	0	0	2	0	1
Undergraduate	35	13	19	26	17	2
First timers	12	6	6	5	0	0
Non CS Students	1	1	0	1	1	0
Educators/Experts	8	4	5	6	5	1
Race	2	1	1	1	0	0
Gender	4	1	2	1	1	0

Evaluation vs Intervention

	Learning to code/Writing Code	Learning to read	Code evaluation	Code explanation	Natural Experiment	Conceptual understanding
Learning/Grades	[45] [16] [18] [78] [8] [24] [30] [31] [63] [55] [34] [28] [40] [66] [32] [11] [65]	[72] [18] [24] [55] [40] [66]	[16] [8] [63] [34] [15] [11]	[1] [16] [18] [75] [31] [46] [76] [55] [34] [66] [11] [65]	[67] [61]	[59] [77] [26]
Code Quality	[17] [16] [8] [20] [56] [74] [79] [32]		[16] [8] [20] [4] [10] [74] [79] [48] [3]	[17] [16] [20] [3] [60]		
Opinion/Perception	[82] [17] [69] [51] [44] [50] [18] [24] [30] [35] [7] [13] [57] [58] [55] [14] [40] [80] [29]	[82] [51] [50] [18] [24] [35] [7] [13] [55] [14] [40] [80] [29]	[82] [9] [37] [35] [7] [13] [10] [12]	[82] [17] [51] [50] [18] [49] [35] [7] [36] [13] [57] [46] [76] [55] [29]	[67] [81] [41] [43] [21] [73] [19] [53] [57] [54] [61] [2] [6]	
Workload	[82] [69] [42] [30] [31] [62] [71]	[82]	[82] [33]	[82] [31]		[26]
Academic Integrity	[82] [45] [30] [57] [64]	[82] [64]	[82] [22] [64]	[82] [57] [64]	[27] [70] [68] [57] [61]	
Deep Feedback	[42] [50] [24] [25] [35] [7] [57] [58] [55] [64] [40] [5] [38] [23]	[50] [24] [35] [7] [55] [64] [40] [23]	[9] [37] [35] [7] [10] [64]	[50] [75] [25] [35] [7] [57] [76] [55] [39] [64] [5] [23]	[67] [81] [73] [68] [57] [54] [61] [2] [38] [6]	

Population vs Evaluation

	Learning /Grades	Code Quality	Opinion /Perception	Workload	Academic Integrity	Deep Feedback
K-12	[77] [31] [76] [32]	[32]	[76]	[31]		[76]
Undergraduate	[67] [1] [59] [45] [16] [18] [78] [8] [24] [30] [75] [63] [46] [55] [34] [15] [61] [28] [40] [66] [11] [65] [26]	[17] [16] [8] [20] [4] [10] [56] [74] [48] [60]	[82] [67] [17] [69] [81] [41] [51] [43] [21] [73] [50] [18] [19] [24] [49] [30] [9] [37] [53] [7] [36] [13] [57] [46] [10] [58] [55] [54] [61] [2] [47] [14] [40] [52] [29] [6] [12]	[82] [69] [42] [33] [30] [26] [71]	[82] [27] [70] [45] [30] [68] [57] [61] [22]	[67] [42] [81] [73] [50] [24] [9] [75] [25] [37] [68] [7] [57] [10] [58] [55] [54] [61] [39] [2] [47] [40] [5] [38] [23] [6]
First time programmers	[24] [31] [63] [55] [15] [32]	[20] [79] [32]	[24] [37] [7] [55] [14] [80] [29]	[42] [31]		[42] [24] [37] [7] [55]
Non CS Students			[73] [50] [52]			[73] [50]
Educators/Experts	[72] [59] [45] [30] [75] [15] [61]	[3]	[82] [41] [44] [30] [35] [57] [54] [61]	[82] [30] [62]	[82] [45] [30] [68] [57] [61] [64]	[75] [35] [68] [57] [54] [61] [64]
Race			[7]	[42]		[42] [7]
Gender		[74] [79]	[50] [6]	[42]		[42] [50] [6]

Population vs Intervention

	Learning to code/Writing Code	Learning to read	Code evaluation	Code explanation	Natural Experiment	Conceptual understanding
K-12	[31] [32]			[31] [76]		[77]
Undergraduate	[82] [17] [69] [42] [45] [16] [51] [50] [18] [78] [8] [24] [30] [25] [20] [7] [63] [13] [57] [56] [58] [55] [34] [74] [28] [14] [40] [5] [66] [38] [11] [23] [65] [29] [71]	[82] [51] [50] [18] [24] [7] [13] [55] [14] [40] [66] [23] [29]	[82] [16] [33] [8] [9] [37] [20] [7] [63] [13] [4] [10] [34] [15] [74] [22] [48] [11] [12]	[82] [17] [1] [16] [51] [50] [18] [49] [75] [25] [20] [7] [36] [13] [57] [46] [55] [34] [39] [5] [66] [11] [23] [65] [29] [60]	[67] [27] [70] [81] [41] [43] [21] [73] [19] [68] [53] [57] [54] [61] [2] [38] [6]	[59] [26]
First time programmers	[42] [24] [31] [20] [7] [63] [55] [79] [14] [80] [32] [29]	[24] [7] [55] [14] [80] [29]	[37] [20] [7] [63] [15] [79]	[31] [20] [7] [55] [29]		
Non CS Students	[50]	[50]		[50]	[73]	
Educators/Experts	[82] [45] [44] [30] [35] [62] [57] [64]	[82] [72] [35] [64]	[82] [35] [15] [64] [3]	[82] [75] [35] [57] [64] [3]	[41] [68] [57] [54] [61]	[59]
Race	[42] [7]	[7]	[7]	[7]		
Gender	[42] [50] [74] [79]	[50]	[74] [79]	[50]	[6]	

[1] Aly Maher Abdelfattah, Nabila Ahmed Ali, Mohamed Abd Elaziz, and Hany H Ammar. 2023. Roadmap for Software Engineering Education using ChatGPT. In *2023 International Conference on Artificial Intelligence Science and Applications in Industry and Society (CAISAIS)*. 1–6. https://doi.org/10.1109/CAISAIS59399.2023.10270477

[2] Matin Amoozadeh, David Daniels, Daye Nam, Aayush Kumar, Stella Chen, Michael Hilton, Sruti Srinivasa Ragavan, and Mohammad Amin Alipour. 2024. Trust in Generative AI among Students: An exploratory study. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 6773. https://doi.org/10.1145/3626252.3630842

[3] Rishabh Balse, Viraj Kumar, Prajish Prasad, and Jayakrishnan Madathil Warriem. 2023. Evaluating the Quality of LLM-Generated Explanations for Logical Errors in CS1 Student Programs. In *Proceedings of the 16th Annual ACM India Compute Conference (COMPUTE '23)*. Association for Computing Machinery, New York, NY, USA, 4954. https://doi.org/10.1145/3627217.3627233

[4] Rishabh Balse, Bharath Valaboju, Shreya Singhal, Jayakrishnan Madathil Warriem, and Prajish Prasad. 2023. Investigating the Potential of GPT-3 in Providing Feedback for Programming Assessments. In *Proceedings of the 2023 Conference on Innovation and Technology in Computer Science Education V. 1 (ITiCSE 2023)*. Association for Computing Machinery, New York, NY, USA, 292298. https://doi.org/10.1145/3587102.3588852

[5] Rasika Bhalerao. 2024. My Learnings from Allowing Large Language Models in Introductory Computer Science Classes. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 2 (SIGCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 15741575. https://doi.org/10.1145/3626253.3635511

[6] Ritvik Budhiraja, Ishika Joshi, Jagat Sesh Challa, Harshal D. Akolekar, and Dhruv Kumar. 2024. It's not like Jarvis, but it's pretty close! - Examining ChatGPT's Usage among Undergraduate Students in Computer Science. In *Proceedings of the 26th Australasian Computing Education Conference (ACE '24)*. Association for Computing Machinery, New York, NY, USA, 124133. https://doi.org/10.1145/3636243.3636257

[7] Chen Cao. 2023. Scaffolding CS1 Courses with a Large Language Model-Powered Intelligent Tutoring System. In *Companion Proceedings of the 28th International Conference on Intelligent User Interfaces (IUI '23 Companion)*. Association for Computing Machinery, New York, NY, USA, 229232. https://doi.org/10.1145/3581754.3584111

[8] Nancy Carr, Farjahan R Shawon, and Hasan M Jamil. 2023. An Experiment on Leveraging ChatGPT for Online Teaching and Assessment of Database Students. In *2023 IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE)*. 1–8. https://doi.org/10.1109/TALE56641.2023.10398239

[9] Henry C. B. Chan. 2023. Grading Generative AI-based Assignments Using a 3R Framework. In *2023 IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE)*. 1–5. https://doi.org/10.1109/TALE56641.2023.10398408

[10] Rudrajit Choudhuri, Dylan Liu, Igor Steinmacher, Marco Gerosa, and Anita Sarma. 2024. How Far Are We? The Triumphs and Trials of Generative AI in Learning Software Engineering. In *Proceedings of the IEEE/ACM 46th International Conference on Software Engineering (ICSE '24)*. Association for Computing Machinery, New York, NY, USA, Article 184, 13 pages. https://doi.org/10.1145/3597503.3639201

[11] Brendan Cowan, Yutaka Watanobe, and Atsushi Shirafuji. 2024. Enhancing Programming Learning with LLMs: Prompt Engineering and Flipped Interaction. In *Proceedings of the 2023 4th Asia Service Sciences and Software Engineering Conference (ASSE '23)*. Association for Computing Machinery, New York, NY, USA, 1016. https://doi.org/10.1145/3634814.3634816

[12] Aaron S. Crandall, Gina Sprint, and Bryan Fischer. 2023. Generative Pre-Trained Transformer (GPT) Models as a Code Review Feedback Tool in Computer Science Programs. *J. Comput. Sci. Coll.* 39, 1 (Oct. 2023), 3847.

[13] Marian Daun and Jennifer Brings. 2023. How ChatGPT Will Change Software Engineering Education. In *Proceedings of the 2023 Conference on Innovation and Technology in Computer Science Education V. 1 (ITiCSE 2023)*. Association for Computing Machinery, New York, NY, USA, 110116. https://doi.org/10.1145/3587102.3588815

[14] Paul Denny, Juho Leinonen, James Prather, Andrew Luxton-Reilly, Thezyrie Amarouche, Brett A. Becker, and Brent N. Reeves. 2024. Prompt Problems: A New Programming Exercise for the Generative AI Era. In *Proceedings of the 55th ACM Technical Symposium on Computer Science*

Education V. 1 (SIGCSE 2024). Association for Computing Machinery, New York, NY, USA, 296302. https://doi.org/10.1145/3626252.3630909

[15] Paul Denny, James Prather, Brett A. Becker, James Finnie-Ansley, Arto Hellas, Juho Leinonen, Andrew Luxton-Reilly, Brent N. Reeves, Eddie Antonio Santos, and Sami Sarsa. 2024. Computing Education in the Era of Generative AI. *Commun. ACM* 67, 2 (Jan. 2024), 5667. https://doi.org/10.1145/3624720

[16] Otávio Lube Dos Santos and Davidson Cury. 2023. Challenging the Confirmation Bias: Using ChatGPT as a Virtual Peer for Peer Instruction in Computer Programming Education. In *2023 IEEE Frontiers in Education Conference (FIE)*. 1–7. https://doi.org/10.1109/FIE58773.2023.10343247

[17] Philipp Haindl and Gerald Weinberger. 2024. Students Experiences of Using ChatGPT in an Undergraduate Programming Course. *IEEE Access* 12 (2024), 43519–43529. https://doi.org/10.1109/ACCESS.2024.3380909

[18] Jana Al Hajj and Melike Sah. 2023. Assessing the Impact of ChatGPT in a PHP Programming Course. In *2023 7th International Symposium on Innovative Approaches in Smart Technologies (ISAS)*. 1–10. https://doi.org/10.1109/ISAS60782.2023.10391549

[19] Khadija Hanifi, Orcun Cetin, and Cemal Yilmaz. 2023. On ChatGPT: Perspectives from Software Engineering Students. In *2023 IEEE 23rd International Conference on Software Quality, Reliability, and Security (QRS)*. 196–205. https://doi.org/10.1109/QRS60937.2023.00028

[20] Arto Hellas, Juho Leinonen, Sami Sarsa, Charles Koutcheme, Lilja Kujanpää, and Juha Sorva. 2023. Exploring the Responses of Large Language Models to Beginner Programmers Help Requests. In *Proceedings of the 2023 ACM Conference on International Computing Education Research - Volume 1 (ICER '23)*. Association for Computing Machinery, New York, NY, USA, 93105. https://doi.org/10.1145/3568813.3600139

[21] Alexander A. Hernandez, Jay Rhald C. Padilla, and Myron Darrel L. Montefalcon. 2023. Information Seeking Behavior in ChatGPT: The Case of Programming Students from a Developing Economy. In *2023 IEEE 13th International Conference on System Engineering and Technology (ICSET)*. 72–77. https://doi.org/10.1109/ICSET59111.2023.10295122

[22] Muntasir Hoq, Yang Shi, Juho Leinonen, Damilola Babalola, Collin Lynch, Thomas Price, and Bita Akram. 2024. Detecting ChatGPT-Generated Code Submissions in a CS1 Course Using Machine Learning Models. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 526532. https://doi.org/10.1145/3626252.3630826

[23] Irene Hou, Sophia Mettille, Owen Man, Zhuo Li, Cynthia Zastudil, and Stephen MacNeil. 2024. The Effects of Generative AI on Computing Students Help-Seeking Preferences. In *Proceedings of the 26th Australasian Computing Education Conference (ACE '24)*. Association for Computing Machinery, New York, NY, USA, 3948. https://doi.org/10.1145/3636243.3636248

[24] Minjie Hu, Tony Assadi, and Hamid Mahroeian. 2023. Explicitly Introducing ChatGPT into First-year Programming Practice: Challenges and Impact. In *2023 IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE)*. 1–6. https://doi.org/10.1109/TALE56641.2023.10398297

[25] Dhanya Jayagopal, Justin Lubin, and Sarah E. Chasins. 2022. Exploring the Learnability of Program Synthesizers by Novice Programmers. In *Proceedings of the 35th Annual ACM Symposium on User Interface Software and Technology (UIST '22)*. Association for Computing Machinery, New York, NY, USA, Article 64, 15 pages. https://doi.org/10.1145/3526113.3545659

[26] Yu Ji, Xuanxuan Zou, Tingting Li, and Zehui Zhan. 2024. The effectiveness of ChatGPT on pre-service teachers' STEM teaching literacy, learning performance, and cognitive load in a teacher training course. In *Proceedings of the 2023 6th International Conference on Educational Technology Management (ICETM '23)*. Association for Computing Machinery, New York, NY, USA, 1622. https://doi.org/10.1145/3637907.3637948

[27] Jinyoung Jo and Sean Choi. 2023. Analysis of Plagiarism via ChatGPT on Domain-Specific Exams. In *2023 Congress in Computer Science, Computer Engineering, and Applied Computing (CSCE)*. 1026–1033. https://doi.org/10.1109/CSCE60160.2023.00171

[28] Ishika Joshi, Ritvik Budhiraja, Harshal Dev, Jahnvi Kadia, Mohammad Osama Ataullah, Sayan Mitra, Harshal D. Akolekar, and Dhruv Kumar. 2024. ChatGPT in the Classroom: An Analysis of Its Strengths and Weaknesses for Solving Undergraduate Computer Science Questions. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 625631. https://doi.org/10.1145/3626252.3630803

[29] Breanna Jury, Angela Lorusso, Juho Leinonen, Paul Denny, and Andrew Luxton-Reilly. 2024. Evaluating LLM-generated Worked Examples in an Introductory Programming Course. In *Proceedings of the 26th Australasian Computing Education Conference (ACE '24)*. Association for Computing Machinery, New York, NY, USA, 7786. https://doi.org/10.1145/3636243.3636252

[30] Oscar Karnalim, Hapnes Toba, Meliana Christianti Johan, Erico Darmawan Handoyo, Yehezkiel David Setiawan, and Josephine Alvina Luwia. 2023. Plagiarism and AI Assistance Misuse in Web Programming: Unfair Benefits and Characteristics. In *2023 IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE)*. 1–5. https://doi.org/10.1109/TALE56641.2023.10398397

[31] Majeed Kazemitabaar, Justin Chow, Carl Ka To Ma, Barbara J. Ericson, David Weintrop, and Tovi Grossman. 2023. Studying the effect of AI Code Generators on Supporting Novice Learners in Introductory Programming. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (CHI '23)*. Association for Computing Machinery, New York, NY, USA, Article 455, 23 pages. https://doi.org/10.1145/3544548.3580919

[32] Majeed Kazemitabaar, Xinying Hou, Austin Henley, Barbara Jane Ericson, David Weintrop, and Tovi Grossman. 2024. How Novices Use LLM-based Code Generators to Solve CS1 Coding Tasks in a Self-Paced Learning Environment. In *Proceedings of the 23rd Koli Calling International Conference on Computing Education Research (Koli Calling '23)*. Association for Computing Machinery, New York, NY, USA, Article 3, 12 pages. https://doi.org/10.1145/3631802.3631806

[33] Natalie Kiesler, Dominic Lohr, and Hieke Keuning. 2023. Exploring the Potential of Large Language Models to Generate Formative Programming Feedback. In *2023 IEEE Frontiers in Education Conference (FIE)*. 1–5. https://doi.org/10.1109/FIE58773.2023.10343457

[34] Kimio Kuramitsu, Yui Obara, Miyu Sato, and Momoka Obara. 2023. KOGI: A Seamless Integration of ChatGPT into Jupyter Environments for Programming Education. In *Proceedings of the 2023 ACM SIGPLAN International Symposium on SPLASH-E (SPLASH-E 2023)*. Association for Computing Machinery, New York, NY, USA, 5059. https://doi.org/10.1145/3622780.3623648

[35] Sam Lau and Philip Guo. 2023. From "Ban It Till We Understand It" to "Resistance is Futile": How University Programming Instructors Plan to Adapt as More Students Use AI Code Generation and Explanation Tools such as ChatGPT and GitHub Copilot. In *Proceedings of the 2023 ACM Conference on International Computing Education Research - Volume 1 (ICER '23)*. Association for Computing Machinery, New York, NY, USA, 106121. https://doi.org/10.1145/3568813.3600138

[36] Juho Leinonen, Paul Denny, Stephen MacNeil, Sami Sarsa, Seth Bernstein, Joanne Kim, Andrew Tran, and Arto Hellas. 2023. Comparing Code Explanations Created by Students and Large Language Models. In *Proceedings of the 2023 Conference on Innovation and Technology in Computer Science Education V. 1 (ITiCSE 2023)*. Association for Computing Machinery, New York, NY, USA, 124130. https://doi.org/10.1145/3587102.3588785

[37] Tiffany Wenting Li, Silas Hsu, Max Fowler, Zhilin Zhang, Craig Zilles, and Karrie Karahalios. 2023. Am I Wrong, or Is the Autograder Wrong? Effects of AI Grading Mistakes on Learning. In *Proceedings of the 2023 ACM Conference on International Computing Education Research - Volume 1 (ICER '23)*. Association for Computing Machinery, New York, NY, USA, 159176. https://doi.org/10.1145/3568813.3600124

[38] Mark Liffiton, Brad E Sheese, Jaromir Savelka, and Paul Denny. 2024. CodeHelp: Using Large Language Models with Guardrails for Scalable Support in Programming Classes. In *Proceedings of the 23rd Koli Calling International Conference on Computing Education Research (Koli Calling '23)*. Association for Computing Machinery, New York, NY, USA, Article 8, 11 pages. https://doi.org/10.1145/3631802.3631830

[39] Mengqi Liu and Faten M'Hiri. 2024. Beyond Traditional Teaching: Large Language Models as Simulated Teaching Assistants in Computer Science. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 743749. https://doi.org/10.1145/3626252.3630789

[40] Rongxin Liu, Carter Zenke, Charlie Liu, Andrew Holmes, Patrick Thornton, and David J. Malan. 2024. Teaching CS50 with AI: Leveraging Generative Artificial Intelligence in Computer Science Education. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 750756. https://doi.org/10.1145/3626252.3630938

[41] Yunkai Liu. 2023. Leveraging the Power of AI in Undergraduate Computer Science Education: Opportunities and Challenges. In *2023 IEEE Frontiers in Education Conference (FIE)*. 1–5. https://doi.org/10.1109/FIE58773.2023.10343474

[42] Mary Lou Maher, Sri Yash Tadimalla, and Dhruv Dhamani. 2023. An Exploratory Study on the Impact of AI tools on the Student Experience in Programming Courses: an Intersectional Analysis Approach. In *2023 IEEE Frontiers in Education Conference (FIE)*. 1–5. https://doi.org/10.1109/FIE58773.2023.10343037

[43] Harry Ma'ruf, Bayu Rima Aditya, Elis Hernawati, Tedi Gunawan, and Pikir Wisnu Wijayanto. 2023. Usability Testing of ChatGPT Website as a Medium for Task Collaboration Using the System Usability Scale Method (SUS). In *2023 8th International Conference on Information Technology and Digital Applications (ICITDA)*. 1–5. https://doi.org/10.1109/ICITDA60835.2023.10427187

[44] JunSeong Moon, RaeEun Yang, SoMin Cha, and Seong Baeg Kim. 2023. chatGPT vs Mentor : Programming Language Learning Assistance System for Beginners. In *2023 IEEE 8th International Conference On Software Engineering and Computer Systems (ICSECS)*. 106–110. https://doi.org/10.1109/ICSECS58457.2023.10256295

[45] Mohamed Morsy, Abdallah Farraj, and David Reavis. 2023. On the Challenges and Opportunities of Using ChatGPT in Academia. In *2023 IEEE Frontiers in Education Conference (FIE)*. 01–06. https://doi.org/10.1109/FIE58773.2023.10343189

[46] Daye Nam, Andrew Macvean, Vincent Hellendoorn, Bogdan Vasilescu, and Brad Myers. 2024. Using an LLM to Help With Code Understanding. In *Proceedings of the IEEE/ACM 46th International Conference on Software Engineering (ICSE '24)*. Association for Computing Machinery, New York, NY, USA, Article 97, 13 pages. https://doi.org/10.1145/3597503.3639187

[47] Andres Neyem, Juan Pablo Sandoval Alcocer, Marcelo Mendoza, Leonardo Centellas-Claros, Luis A. Gonzalez, and Carlos Paredes-Robles. 2024. Exploring the Impact of Generative AI for StandUp Report Recommendations in Software Capstone Project Development. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 951957. https://doi.org/10.1145/3626252.3630854

[48] Ha Nguyen and Vicki Allan. 2024. Using GPT-4 to Provide Tiered, Formative Code Feedback. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 958964. https://doi.org/10.1145/3626252.3630960

[49] Abdessalam Ouaazki, Kristoffer Bergram, and Adrian Holzer. 2023. Leveraging ChatGPT to Enhance Computational Thinking Learning Experiences. In *2023 IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE)*. 1–7. https://doi.org/10.1109/TALE56641.2023.10398358

[50] Jay Rhald C. Padilla, Myron Darrel L. Montefalcon, and Alexander A. Hernandez. 2023. Language AI in Programming: A Case Study of ChatGPT in Higher Eduation Using Natural Language Processing. In *2023 IEEE 11th Conference on Systems, Process & Control (ICSPC)*. 276–281. https://doi.org/10.1109/ICSPC59664.2023.10420194

[51] K. G. D. K. Perera, J. Wijayanayake, and J. Prasadika. 2024. Factors Affecting the Effectiveness of Generative Artificial Intelligence Apps on University Students' Programming Language Learning in Sri Lanka: A Systematic Literature Review. In *2024 4th International Conference on Advanced Research in Computing (ICARC)*. 276–281. https://doi.org/10.1109/ICARC61713.2024.10499744

[52] Olga Petrovska, Lee Clift, Faron Moller, and Rebecca Pearsall. 2024. Incorporating Generative AI into Software Development Education. In *Proceedings of the 8th Conference on Computing Education Practice (CEP '24)*. Association for Computing Machinery, New York, NY, USA, 3740. https://doi.org/10.1145/3633053.3633057

[53] Siddhartha Prasad, Ben Greenman, Tim Nelson, and Shriram Krishnamurthi. 2023. Generating Programs Trivially: Student Use of Large Language Models. In *Proceedings of the ACM Conference on Global Computing Education Vol 1 (CompEd 2023)*. Association for Computing Machinery, New York, NY, USA, 126132. https://doi.org/10.1145/3576882.3617921

[54] James Prather, Paul Denny, Juho Leinonen, Brett A. Becker, Ibrahim Albluwi, Michelle Craig, Hieke Keuning, Natalie Kiesler, Tobias Kohn, Andrew Luxton-Reilly, Stephen MacNeil, Andrew Petersen, Raymond Pettit, Brent N. Reeves, and Jaromir Savelka. 2023. The Robots Are Here: Navigating the Generative AI Revolution in Computing Education. In *Proceedings of the 2023 Working Group Reports on Innovation and Technology in Computer Science Education (ITiCSE-WGR '23)*. Association for Computing Machinery, New York, NY, USA, 108159. https://doi.org/10.1145/3623762.3633499

[55] James Prather, Brent N. Reeves, Paul Denny, Brett A. Becker, Juho Leinonen, Andrew Luxton-Reilly, Garrett Powell, James Finnie-Ansley, and Eddie Antonio Santos. 2023. Its Weird That it Knows What I Want: Usability and Interactions with Copilot for Novice Programmers. *ACM Trans. Comput.-Hum. Interact.* 31, 1, Article 4 (Nov. 2023), 31 pages. https://doi.org/10.1145/3617367

[56] Basit Qureshi. 2023. ChatGPT in Computer Science Curriculum Assessment: An analysis of Its Successes and Shortcomings. In *Proceedings of the 2023 9th International Conference on E-Society, e-Learning and e-Technologies (ICSLT '23)*. Association for Computing Machinery, New York, NY, USA, 713. https://doi.org/10.1145/3613944.3613946

[57] Parsa Rajabi, Parnian Taghipour, Diana Cukierman, and Tenzin Doleck. 2023. Exploring ChatGPTs impact on post-secondary education: A qualitative study. In *Proceedings of the 25th Western Canadian Conference on Computing Education (WCCCE '23)*. Association for Computing Machinery, New York, NY, USA, Article 9, 6 pages. https://doi.org/10.1145/3593342.3593360

[58] Jaakko Rajala, Jenni Hukkanen, Maria Hartikainen, and Pia Niemelä. 2023. "C̈all me Kiran¨ ChatGPT as a Tutoring Chatbot in a Computer Science Course". In *Proceedings of the 26th International Academic Mindtrek Conference (Mindtrek '23)*. Association for Computing Machinery, New York, NY, USA, 8394. https://doi.org/10.1145/3616961.3616974

[59] Sarah Reynolds, William C. Pate, and Omar Ochoa. 2023. An Ontology and Management System for Learning Outcomes and Student Mastery. In *2023 IEEE Frontiers in Education Conference (FIE)*. 1–5. https://doi.org/10.1109/FIE58773.2023.10343171

[60] Lianne Roest, Hieke Keuning, and Johan Jeuring. 2024. Next-Step Hint Generation for Introductory Programming Using Large Language Models. In *Proceedings of the 26th Australasian Computing Education Conference (ACE '24)*. Association for Computing Machinery, New York, NY, USA, 144153. https://doi.org/10.1145/3636243.3636259

[61] Michael P. Rogers, Hannah Miller Hillberg, and Christopher L. Groves. 2024. Attitudes Towards the Use (and Misuse) of ChatGPT: A Preliminary Study. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 11471153. https://doi.org/10.1145/3626252.3630784

[62] Eddie Antonio Santos, Prajish Prasad, and Brett A. Becker. 2023. Always Provide Context: The Effects of Code Context on Programming Error Message Enhancement. In *Proceedings of the ACM Conference on Global Computing Education Vol 1 (CompEd 2023)*. Association for Computing Machinery, New York, NY, USA, 147153. https://doi.org/10.1145/3576882.3617909

[63] Jaromir Savelka, Arav Agarwal, Christopher Bogart, Yifan Song, and Majd Sakr. 2023. Can Generative Pre-trained Transformers (GPT) Pass Assessments in Higher Education Programming Courses?. In *Proceedings of the 2023 Conference on Innovation and Technology in Computer Science Education V. 1 (ITiCSE 2023)*. Association for Computing Machinery, New York, NY, USA, 117123. https://doi.org/10.1145/3587102.3588792

[64] Judy Sheard, Paul Denny, Arto Hellas, Juho Leinonen, Lauri Malmi, and Simon. 2024. Instructor Perceptions of AI Code Generation Tools - A Multi-Institutional Interview Study. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 12231229. https://doi.org/10.1145/3626252.3630880

[65] Brad Sheese, Mark Liffiton, Jaromir Savelka, and Paul Denny. 2024. Patterns of Student Help-Seeking When Using a Large Language Model-Powered Programming Assistant. In *Proceedings of the 26th Australasian Computing Education Conference (ACE '24)*. Association for Computing Machinery, New York, NY, USA, 4957. https://doi.org/10.1145/3636243.3636249

[66] Abdulhadi Shoufan. 2023. Can Students without Prior Knowledge Use ChatGPT to Answer Test Questions? An Empirical Study. *ACM Trans. Comput. Educ.* 23, 4, Article 45 (Dec. 2023), 29 pages. https://doi.org/10.1145/3628162

[67] Abdulhadi Shoufan. 2023. Exploring Students Perceptions of ChatGPT: Thematic Analysis and Follow-Up Survey. *IEEE Access* 11 (2023), 38805–38818. https://doi.org/10.1109/ACCESS.2023.3268224

[68] Adele Smolansky, Andrew Cram, Corina Raduescu, Sandris Zeivots, Elaine Huber, and Rene F. Kizilcec. 2023. Educator and Student Perspectives on the Impact of Generative AI on Assessments in Higher Education. In *Proceedings of the Tenth ACM Conference on Learning @ Scale (L@S '23)*. Association for Computing Machinery, New York, NY, USA, 378382. https://doi.org/10.1145/3573051.3596191

[69] Sandro Speth, Niklas MeiSSner, and Steffen Becker. 2023. Investigating the Use of AI-Generated Exercises for Beginner and Intermediate Programming Courses: A ChatGPT Case Study. In *2023 IEEE 35th International Conference on Software Engineering Education and Training (CSEE&T)*. 142–146. https://doi.org/10.1109/CSEET58097.2023.00030

[70] Zachary Taylor, Cy Blair, Ethan Glenn, and Thomas Ryan Devine. 2023. Plagiarism in Entry-Level Computer Science Courses Using ChatGPT. In *2023 Congress in Computer Science, Computer Engineering, & Applied Computing (CSCE)*. 1135–1139. https://doi.org/10.1109/CSCE60160.2023.00189

[71] Andreas Tolk, Philip Barry, Margaret L. Loper, Ghaith Rabadi, William T. Scherer, and Levent Yilmaz. 2024. Chances and Challenges of Chatgpt and Similar Models for Education in M&S. In *Proceedings of the Winter Simulation Conference (WSC '23)*. IEEE Press, 33323346.

[72] Andrew Tran, Kenneth Angelikas, Egi Rama, Chiku Okechukwu, David H. Smith, and Stephen MacNeil. 2023. Generating Multiple Choice Questions for Computing Courses Using Large Language Models. In *2023 IEEE Frontiers in Education Conference (FIE)*. 1–8. https://doi.org/10.1109/FIE58773.2023.10342898

[73] Marcel Valový and Alena Buchalcevova. 2023. The Psychological Effects of AI-Assisted Programming on Students and Professionals. In *2023 IEEE International Conference on Software Maintenance and Evolution (ICSME)*. 385–390. https://doi.org/10.1109/ICSME58846.2023.00050

[74] Sierra Wang, John Mitchell, and Chris Piech. 2024. A Large Scale RCT on Effective Error Messages in CS1. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 13951401. https://doi.org/10.1145/3626252.3630764

[75] Tianjia Wang, Daniel Vargas Díaz, Chris Brown, and Yan Chen. 2023. Exploring the Role of AI Assistants in Computer Science Education: Methods, Implications, and Instructor Perspectives. In *2023 IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC)*. 92–102. https://doi.org/10.1109/VL-HCC57772.2023.00018

[76] Randi Williams, Safinah Ali, Raúl Alcantara, Tasneem Burghleh, Sharifa Alghowinem, and Cynthia Breazeal. 2024. Doodlebot: An Educational Robot for Creativity and AI Literacy. In *Proceedings of the 2024 ACM/IEEE International Conference on Human-Robot Interaction (HRI '24)*. Association for Computing Machinery, New York, NY, USA, 772780. https://doi.org/10.1145/3610977.3634950

[77] Randi Williams, Hae Won Park, and Cynthia Breazeal. 2019. A is for Artificial Intelligence: The Impact of Artificial Intelligence Activities on Young Children's Perceptions of Robots. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19)*. Association for Computing Machinery, New York, NY, USA, 111. https://doi.org/10.1145/3290605.3300677

[78] Jan H.R. Woerner, Aleksandra P. Turtova, and Andrew S.I.D. Lang. 2024. Transformative Potentials and Ethical Considerations of AI Tools in Higher Education: Case Studies and Reflections. In *SoutheastCon 2024*. 510–515. https://doi.org/10.1109/SoutheastCon52093.2024.10500042

[79] Juliette Woodrow, Ali Malik, and Chris Piech. 2024. AI Teaches the Art of Elegant Coding: Timely, Fair, and Helpful Style Feedback in a Global Course. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 14421448. https://doi.org/10.1145/3626252.3630773

[80] Hao Wu, Daidong Fa, Xiaoling Wu, Weijun Tan, Xiwen Chang, Ying Gao, and Jinta Weng. 2024. Research on the Construction of Intelligent Programming Platform Based on AI-generated Content. In *Proceedings of the 15th International Conference on Education Technology and Computers (ICETC '23)*. Association for Computing Machinery, New York, NY, USA, 915. https://doi.org/10.1145/3629296.3629298

[81] Cynthia Zastudil, Magdalena Rogalska, Christine Kapp, Jennifer Vaughn, and Stephen MacNeil. 2023. Generative AI in Computing Education: Perspectives of Students and Instructors. In *2023 IEEE Frontiers in Education Conference (FIE)*. 1–9. https://doi.org/10.1109/FIE58773.2023.10343467

[82] Dongdong Zhang, Qian Cao, Yuchen Guo, and Lisheng Wang. 2024. Assistant Teaching System for Computer Hardware Courses Based on Large Language Model. *Communications in Computer and Information Science* 2023 CCIS (2024), 301 313. https://doi.org/10.1007/978-981-97-0730-0_27 Cited by: 0.