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The Integration and Impact of AI Chatbots within Modern IDEs

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Abstract: *AI code assistants and chatbots integrated into modern Integrated Development Environments (IDEs) help developers write, understand, and maintain software faster by suggesting code, generating boilerplate, and explaining complex logic. This review paper examines how tools such as GitHub Copilot, Visual Studio Code (VS Code) Chat, and other AI copilots are changing day-to-day developer workflows in academic, enterprise, and open-source settings. It summarizes reported productivity gains, such as reduced typing effort and quicker access to examples, as well as risks related to code quality, security, and reduced deep understanding of underlying logic. The paper combines findings from empirical studies, industry reports, and guidance from vendors to discuss where AI assistants are most helpful, where they may introduce errors or vulnerabilities, and how developers and organizations can adopt these tools in a balanced and responsible way.*

Keywords: GitHub Copilot, Code Assistant, Integrated Development Environment, Developer Productivity, Code Security, VS Code Chat

I. INTRODUCTION

Traditional Integrated Development Environments (IDEs) such as Visual Studio, Eclipse, and earlier versions of Visual Studio Code were mainly focused on editing, building, and debugging code. They provided syntax highlighting, basic auto-complete, and integration with compilers or interpreters, but almost all logic was still written manually by the programmer.

In the last few years, AI code assistants and chatbots have been integrated directly into IDEs. GitHub Copilot can suggest entire lines or blocks of code based on comments and existing context, while VS Code Chat and other AI copilots allow developers to ask natural language questions, request explanations, or generate refactorings without leaving the editor. These assistants are powered by large language models that have been trained on large collections of source code and technical text.

For students and professional developers, these features change how coding sessions look. Instead of switching between the IDE, browser, and documentation websites, many tasks can now be handled directly through AI suggestions and in-editor chat. At the same time, this shift raises questions about how much developers should rely on AI, what impact it has on learning and deep understanding of algorithms, and whether AI-generated code is always correct and secure. This paper reviews current knowledge about these questions with a focus on practical implications for everyday development.

II. PROBLEM STATEMENT AND OBJECTIVES

AI code assistants are often marketed as intelligent pair programmers that can save time and reduce routine work. However, developers and organizations are still unsure how much to trust AI-generated code. Research shows that AI suggestions can be helpful but may also be incomplete, incorrect, or insecure if accepted without review. This uncertainty makes it difficult to define clear policies and teaching practices for AI use in software development.

The central problem addressed in this paper is how AI chatbots and code assistants inside IDEs influence productivity, code quality, security, and developer skills, and how they should be governed in educational and industrial

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environments. The key issue is not whether these tools should be used, but how to integrate them in a balanced way so that speed benefits are achieved without sacrificing understanding or safety.

Based on this problem, the main objectives of this paper are:

- To study how developers actually use AI assistants in their day-to-day coding workflows inside modern IDEs.
- To summarize reported productivity gains and perceived improvements in efficiency when using AI code assistants.
- To highlight concerns about correctness, maintainability, and security in AI-generated or AI-assisted code.
- To discuss cognitive and learning effects, including changes in how developers read, reason about, and debug code.
- To suggest best practices and governance guidelines for safe and responsible adoption of AI code assistants in organizations and academic programs.

III. RESEARCH METHOD

This paper follows a literature-based review method instead of new experimental work. It draws on empirical studies, conceptual papers, and practitioner reports that examine GitHub Copilot and similar AI code assistants from different angles, including productivity, usability, code quality, and security.

The review focuses on selected studies that evaluate Copilot in comparison with human pair programming, measure developer expectations and actual experiences, assess the correctness and maintainability of AI-generated code, and analyse security weaknesses in AI-assisted solutions. In addition, guidance from Microsoft documentation and practitioner articles on AI-powered IDE workflows is included to understand how vendors and experienced developers recommend using these tools.

The sources were read to identify recurring themes such as productivity gains, misunderstanding of generated code, over-reliance on suggestions, and the need for verification and governance. These themes are used to structure the literature review and to connect research findings with practical workflow examples and recommendations.

IV. LITERATURE REVIEW

A. AI Code Assistants Overview

AI code assistants such as GitHub Copilot are built on large language models that can generate source code from natural language prompts and partial program context. These tools are presented as "AI pair programmers" that work inside the IDE and provide inline suggestions or chat-style explanations while the developer types.

Imai [1] compares GitHub Copilot with human pair programming and notes that Copilot can generate more lines of code in the same period, but the overall quality of AI-assisted code is generally lower than code written with a human partner. This suggests that Copilot behaves more like a fast auto-completion tool than a full replacement for human collaboration.

Vendor documentation from Microsoft Developer Relations [9] describes Copilot and related copilots in Visual Studio Code as assistants that can help draft code, tests, and documentation and can answer questions about the project. Practitioner articles such as the Towards Data Science technology review on AI-powered IDE workflows [10] emphasise that these tools are now integrated into daily development, especially for repetitive tasks, learning new APIs, and exploring unfamiliar code bases.

B. Developer Experience and Productivity

Several studies look at how developers perceive productivity when using Copilot. Vaithilingam, Zhang, and Glassman [2] study Copilot in a controlled environment and find that it does not always reduce task completion time or increase success rates. However, many participants still prefer to keep using Copilot because it provides a useful starting point and reduces the effort of searching online for examples.

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Ziegler and colleagues [8] analyse telemetry and survey data from thousands of Copilot users. Their study reports that developers who accept more AI suggestions per day tend to report higher perceived productivity. The acceptance rate of suggestions is found to be a better predictor of perceived productivity than strict time-based measurements. This means developers feel more productive when they frequently accept suggestions, even if the objective time savings are not always clear.

Grounded theory work by Barke, James, and Polikarpova [5] observes two main modes of interaction with Copilot: acceleration mode, where the programmer already knows what to do and uses AI to type faster, and exploration mode, where the programmer is unsure how to proceed and uses AI suggestions to explore possible directions. This pattern matches everyday experience in IDEs where AI helps both with routine code and with brainstorming alternative designs.

C. Code Quality and Security Concerns

Nguyen and Nadi [4] empirically evaluate the correctness and understandability of Copilot-generated solutions for a set of programming problems. They find that correctness varies by language, with some languages reaching around half of the tasks solved correctly while others perform lower. Overall, the generated code tends to have relatively low cyclomatic complexity, but some solutions rely on helper methods or patterns that are not clearly defined, which can confuse readers.

Other empirical studies on neural code generation tools and Copilot as a trustworthy assistant, such as the work by Dakhel and colleagues [6], show that while AI-generated code can often compile and pass simple tests, it may contain subtle bugs or design choices that reduce maintainability. Formal verification work and quality assessments report that some generated solutions can be verified against specifications, but this requires careful human oversight and does not guarantee that all suggestions are safe to use without modification.

Security-focused research raises specific concerns. Sandoval and co-authors [7] study the security impact of AI-assisted code generation for low-level C tasks. They find that AI-assisted users do not always introduce more critical security bugs than a control group, but vulnerabilities such as missing input validation, unsafe pointer handling, and other weaknesses still appear. These findings align with broader discussions about common security issues in AI-generated code and show that AI assistance does not automatically make code more secure.

D. Human–AI Collaboration in Programming

Human–AI collaboration in programming is different from traditional pair programming. Imai [1] notes that while Copilot can act as a constant partner that suggests code, it does not provide the same level of explanation, questioning, or shared understanding as a human peer. Developers must therefore take on the role of reviewers and curators of AI output rather than equal conversation partners.

Barke, James, and Polikarpova [5] report that programmers often shift between reading AI-generated code, editing it, and writing their own logic, sometimes many times within a single task. Vaithilingam and colleagues [2] observe that some users treat Copilot as a replacement for web search, asking it for snippets instead of manually looking up documentation. This can speed up work but may also reduce active learning if developers do not take time to deeply understand why a suggestion works.

More recent survey and perspective papers, such as the work by Jayanthi and co-authors [3], argue that Copilot can be helpful for routine patterns and educational use but must be combined with strong code review, testing, and security practices. The role of the developer becomes closer to a supervisor who checks assumptions, adapts suggestions to the local context, and ensures that long-term maintainability and organisational standards are respected.

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V. PRACTICAL WORKFLOW EXAMPLES

To make the discussion more concrete, this section describes simple workflows where AI assistants inside IDEs are commonly used. These examples show both the benefits and the possible issues that can appear if suggestions are accepted without enough review.

First, consider a developer writing boilerplate code for a web API controller. In VS Code with Copilot enabled, the developer can write a short comment such as "create a REST endpoint to fetch student details by ID" and start typing the function signature. Copilot will often suggest the full function body, including parameter handling and a database query. This can save time and reduce typing effort, especially for repetitive patterns. However, if the suggestion does not include proper input validation or error handling, and the developer accepts it as-is, the resulting code may be vulnerable to injection attacks or may expose internal errors to users.

Second, for refactoring an existing function, a programmer can select the code and ask an AI chat inside the IDE to make it more readable, split it into smaller functions, or convert it to a different design pattern. The assistant may produce a cleaner version that removes duplication and improves naming. This helps когда the developer has limited time or is not fully familiar with the code base. On the other hand, if the refactoring removes important edge-case checks or changes the order of operations in a subtle way, the behaviour could change unexpectedly. Tests and careful review are still required.

Third, AI assistants are frequently used for explanations and learning. A beginner may highlight a loop or a complex regular expression and ask the chat bot in VS Code to explain it line by line. The explanation can reduce confusion and support self-study without searching multiple websites. The risk is that explanations may be incomplete or slightly inaccurate, and students may rely only on these summaries instead of consulting official documentation or textbooks.

VI. FINDINGS AND DISCUSSION

Across the reviewed literature and workflow examples, a consistent pattern appears: AI code assistants are most effective for routine or well-structured tasks, but they can be less reliable for complex logic, security-sensitive components, or areas where requirements are not clearly specified. When developers already understand what they want to implement, AI can accelerate typing and reduce the need to remember exact syntax. This matches the "acceleration mode" described by Barke and co-authors [5].

Productivity gains are strongest when AI suggestions replace mechanical work, such as writing boilerplate, scaffolding tests, or translating straightforward logic between languages or frameworks. Ziegler and colleagues [8] show that developers who frequently accept suggestions tend to feel more productive, and Vaithilingam and co-authors [2] report that Copilot often provides helpful starting points that reduce the effort of online search.

However, several risks appear when developers treat AI suggestions as correct by default. Studies on code quality and security highlight that AI-generated code may pass simple tests but still contain hidden bugs or missing checks. Sandoval and colleagues [7] and Dakhel et al. [6] provide evidence that security weaknesses, including missing validation and use of unsafe patterns, can appear in AI-assisted solutions. If developers accept suggestions without review, these weaknesses can silently enter production systems.

There are also cognitive and educational concerns. If students or junior developers rely heavily on AI to solve exercises or complete assignments, they may not fully develop their own problem-solving skills. Observational work shows that some users skip understanding and focus mainly on editing AI output. Over time, this could reduce confidence in manual coding and debugging, making developers less prepared to handle situations where AI is unavailable or wrong.

On the positive side, when used thoughtfully, AI assistants can support learning by providing quick explanations, alternative implementations, and examples for unfamiliar APIs. The key is that developers stay actively engaged—questioning suggestions, running tests, and comparing AI-generated code with their own understanding. In this sense, AI becomes a learning partner rather than a shortcut that avoids thinking.

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VII. RECOMMENDATIONS AND BEST PRACTICES

Based on the reviewed studies and practical observations, the following recommendations and best practices can guide safer and more effective use of AI code assistants inside modern IDEs:

- Always review AI-generated code carefully before adding it to a shared code base. Developers should read suggestions line by line, check logic against requirements, and make necessary edits.
- Use AI assistants mainly for assistance, such as generating boilerplate, suggesting alternative approaches, or explaining code, rather than as a complete replacement for personal understanding and design decisions.
- Combine AI-generated code with strong testing practices. Unit tests, integration tests, and regression tests should be applied to both human-written and AI-assisted code to catch hidden defects.
- Apply secure coding practices and static analysis tools to AI-assisted projects. Tools for detecting common vulnerabilities, such as missing input validation or hard-coded secrets, can help identify security issues in AI-generated code.
- Follow organizational policies for AI usage and data privacy. Developers should avoid sending confidential code or data to external AI services unless contracts and technical controls are in place.
- In educational settings, encourage students to practise manual coding and problem-solving before relying heavily on AI tools. Clear guidelines can clarify when AI assistance is allowed and how it should be cited or documented.
- Train teams to understand both the strengths and the limitations of AI code assistants. Workshops or internal documentation can share examples where AI helped and where it produced incorrect or insecure results.

VIII. CONCLUSION

AI chatbots and code assistants integrated into modern IDEs such as Visual Studio Code represent an important shift in how software is written and maintained. Tools like GitHub Copilot and VS Code Chat help developers work faster by generating code, suggesting improvements, and providing in-context explanations without leaving the editor.

The reviewed literature shows that these tools can increase perceived productivity and reduce routine effort, particularly when used for boilerplate, familiar patterns, and learning new APIs. At the same time, empirical studies also show that AI-generated code is not always correct or secure, and that over-reliance on suggestions can reduce deep engagement with problem solving and design.

For developers, educators, and organizations, the main challenge is to balance speed with safety and learning. AI code assistants should be treated as powerful helpers that still require human supervision. With disciplined review, testing, security checks, and clear governance policies, teams can gain the benefits of AI-augmented development while protecting code quality, security, and professional skills.

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