Uso de la Inteligencia Artificial en la Enseñanza de la Programación: un Estudio Preliminar

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Abstract. Una ola de Inteligencia Artificial (IA) ha invadido la sociedad impulsada en gran medida por los avances de la Inteligencia Artificial Generativa y los modelos de lenguaje a gran escala. La educación no es ajena a este fenómeno. La IA ya está presente en los ámbitos educativos, independientemente de la posición de los docentes. No son pocos los estudiantes que ya están utilizando herramientas de IA en sus tareas. Esto obliga a que como docentes tomemos cartas en el asunto para poder orientar el uso de IA y convertir potenciales riesgos en oportunidades. En el área de la enseñanza de programación el escenario es especialmente atractivo, existe un variado ecosistema de herramientas y si bien ya se pueden encontrar algunas experiencias documentadas del uso de IA en la enseñanza de programación, las mismas son aún incipientes. Este trabajo, aún en progreso, tiene un carácter exploratorio y pretende relevar la perspectiva de los docentes de programación. Como parte de este relevamiento, además de revisar literatura se realizó una encuesta la cual se describe en el este artículo. Los resultados de la encuesta indican entre otras cuestiones que el 69.23 % de los encuestados ya utilizan herramientas basada en IA en sus tareas docentes tales como preparar clases. Al mismo tiempo el 73 % considera que la incorporación de herramientas basadas en IA requiere un cambio relevante en la forma de enseñanza de su materia.

Keywords: Educación · Programación · Inteligencia Artificial.

Artificial Intelligence in Programming Education: A Preliminary Study

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Abstract. A wave of Artificial Intelligence (AI) has swept through society, driven largely by advances in Generative AI and Large Language Models (LLMs). Education is not immune to this phenomenon, and its impact on teaching is becoming increasingly evident, regardless of teachers' stances on the matter. Many students are already using AI tools in their assignments, making it imperative for educators to take action to guide AI usage and turn potential risks into opportunities. In the field of programming education, this scenario is particularly compelling. A diverse ecosystem of tools is already available, and while some documented experiences of AI integration already exist, the topic remains in its early stages. This ongoing study is exploratory in nature and focuses on assessing the perspectives of programming educators. As part of this assessment, a survey was conducted in addition to a literature review, both are described in this article. The survey results indicate, among other findings, that 69.23 % of respondents already use AI-based tools for teaching-related tasks, such as lesson preparation. At the same time, 73 % believe that integrating AI-based tools requires a significant change in how their subject is taught.

Keywords: Education, Programming, Artificial Intelligence.

1 Introduction

Artificial Intelligence (AI) has undergone significant advancement in recent years, particularly with the development of Large Language Models (LLMs) and Generative Artificial Intelligence (GenAI). Education is not exempt from this phenomenon. Tools such as GitHub Copilot have proven capable of successfully solving programming tasks in introductory programming courses, and students have begun to use them actively. This emerging reality poses a challenge for teachers, who must articulate their position on this matter. While some educators perceive the use of these tools as a risk and seek ways to restrict or avoid their use, others see AI as an opportunity for enhancing learning. For this reason some teachers are seeking to better understand the situation in order to guide the use of AI.

Given the described situation, we started a research project to understand how to integrate AI in the programming education. To kickstart the project we started by trying to understands the current state of AI in programming education, this is what this article describes.With this in mind we set two research questions: **RQ1 :** *What is the degree of adoption of AI-based tools in programming education?* and **RQ2:** *Which AI-based tools are the most widely adopted?*.

To address these questions we began by reviewing related work, which is detailed in Section 2. We then conducted a survey targeting programming educators, which is detailed along with our research methodology in Section 3. The results of the survey are summarized and discussed in Section 4. Finally, in Section 5, we present our conclusions and outline directions for future research.

2 Related Work

In this section we summarize some relevant works related to our research topic.

Simaremare et al. (Simaremare et al., 2024) conducted a survey among students in Indonesia to investigate the adoption of Generative Artificial Intelligence tools. The results showed that 98.96 % of the surveyed students had used generative AI tools to support their learning, with GitHub Copilot and ChatGPT being the most commonly used.

Bull y Kharrufa (Bull & Kharrufa, 2024) carried out a qualitative study involving interviews with professional programmers applying thematic analysis techniques. Their findings highlight the significant potential of Artificial Intelligence in the context of software development education, and that both, educators and students, can benefit from its use.

Puryear y Sprint (Puryear & Sprint, 2022) as part of an initial exploration, examined the effects of GitHub Copilot on the programming learning process. They evaluated Copilot-generated solutions to programming exercises from multiple perspectives and found that the tool predominantly produced original code capable of solving introductory-level tasks, with scores between 68 % and 95 %. Based on these preliminary findings, the authors offer recommendations to support educators in adapting their courses.

Boguslawski et al. (Boguslawski et al., 2024) investigated the impact of Artificial Intelligence on student motivation by conducting interviews and surveys with both teachers and students. Their findings indicate that students are predominantly using Large Language Models (LLMs), and that such use can significantly enhance their autonomy and motivation.

Rina Zviel-Girshin (Zviel-Girshin, 2024) conducted a study with 73 teams of students in an introductory programming course to analyze the impact of AI tools on novice programming education. Her findings show that 100 % of the students had used this kind of tools, improving their results by allowing the identification of errors and increasing their satisfaction. At the same time some concerns where identified regarding the excessive dependency on AI tools and their influence in the understanding of the fundamental concepts. The study

highlights the need of a balanced approach in the integration of AI tools in the education.

Saari et al. (Saari et al., 2024) conducted a survey with over 200 students in the field of programming to investigate the impact of AI in higher education. Their findings revealed a lack of understanding regarding the use and implications of AI in these courses. In response to this issue, the authors proposed a set of best practices to guide students and educators in the responsible use of AI, emphasizing the importance of a critical approach toward the results generated by these tools and their role as a complementary resource in the learning process.

Abdulla et al. (Abdulla et al., 2024) conducted an experimental study in an introductory programming course at Sultan Qaboos University (Oman) to evaluate the impact of ChatGPT on student performance. The findings indicate that integrating AI has a positive effect on student outcomes and suggest that its formal incorporation into the curriculum may be beneficial, provided it complements rather than replaces traditional teaching methodologies. Nonetheless, the study also underscores the challenges associated with students' access to large language models (LLMs), particularly in relation to the reliable assessment of their knowledge.

Deriba et al. (Deriba et al., 2024) conducted a systematic literature review on the use of GenAI tools in programming education, analyzing 37 recent studies. They found that most of the work focuses on higher education, with Python as the most commonly used language and tools such as ChatGPT, GitHub Copilot, and Google Bard being the most popular. Their analysis reveals that GenAI enhances students' motivation and interest, but also raises concerns about excessive dependence on these tools, which may hinder the development of programming skills.

3 Methodology

After a review of the related literature and as part of our research, we designed a survey that included 10 questions[1]. The survey was implemented using Google Forms and distributed via email. Initially, the researchers contacted individuals within their personal networks, who were then invited to recommend further participants, thereby generating a snowball sampling effect. The survey results and corresponding analysis are presented in the following sections.

4 Results

A total of 27 responses were collected, with one excluded due to a reported affiliation with a nonexistent institution and the respondent being unreachable for verification. This resulted in 26 usable responses from 12 different universities [2], all located in Argentina. All respondents are professors in computer science or information technology programs.

[1] Survey form available at https://doi.org/10.6084/m9.figshare.29403737

[2] The list of universities is available at https://doi.org/10.6084/m9.figshare.29403551

According to the collected data, 69.23 % of respondents indicated they use some form of AI-based tool in their teaching-related task mainly for preparing their lessons. At the same time, 23.08 % reported that they do not plan to incorporate AI-based tools into their practice.

Meanwhile, 73.08 % of respondents believe that incorporating AI tools requires a substantial change in how their subject is taught. Interestingly, even some respondents who do not currently use AI expressed that its adoption would entail major changes to their courses—an aspect that may, in part, explain their reluctance to adopt such tools.

Some respondents (19.23 %) indicated that their students use AI tools under teacher guidance, while others (76.08 %) believe their students use them on their-own. These responses suggest that a potential 92.31 % of students may already be using AI tools in their studies.

In terms of tool usage, ChatGPT was reported as the most widely used (69.2 %), followed by Gemini (26.9 %) and GitHub Co-Pilot (23.1 %).

Opinions on the emergence of AI in education were markedly divided. This was assessed through the question: "How positive/negative do you consider the irruption of AI in education?" Responses were recorded on a 5-point Likert scale, where 1 indicated "very negative" and 5 indicated "very positive." The distribution of responses is presented in the table 1.

Table 1. How positive/negative do you consider the irruption of AI in education?

Scale	Count of Answers
1 (very negative)	2
2	4
3	8
4	6
5 (very positive)	5

The last question of the survey asked participants to freely share any additional comment and/or clarification related to their previous responses. Here, most participants expressed uncertainty about how to effectively integrate AI into teaching, as well as concerns about potential misuse by students.

5 Conclusions and Future Works

This exploratory work constitutes an initial step in our broader research project on the use of AI in programming education. We acknowledge the survey's limited sample size, which may exhibit a degree of bias due to the proximity of the respondents. Nevertheless, we consider the collected data to be adequate for drawing preliminary conclusions and for informing future research directions. In relation to our first research question: *What is the degree of adoption of AI-based tools in programming education?*, the findings suggest a high level of adoption, with over 73.08 % of respondents are already using AI-based tools in

their teaching activities. Similarly, in relation to our second research question: *Which AI-based tools are the most widely adopted?*, the most used tool among respondents is ChatGPT followed by Gemini and GitHub Co-Pilot. It is also important to highlight that opinions on the positive and negative aspects of AI in education are quite divided.

Based on these initial results, we identify two potential lines of future work. On the one hand, we aim to continue exploring the use of AI-based by replicating this study with a larger sample size, potentially extending it to a regional or international scope. On the other hand, we intend to conduct a more in-depth examination of specific applications of AI-based and recommendations relevant to its integration in programming education.

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