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How to Teach Programming in the AI Era? A Professors' Perspective

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Abstract– ***In recent years, many questions have arisen regarding the use of generative AI in programming courses. There are concerns about the development of students' programming skills, the relevance of continuing to teach computer programming to all students, the best way to introduce AI tools to programming classes, ethical issues, and their appropriate use, among other aspects. In this work, we conducted a survey with a group of professors at our university to gather their perceptions on these topics. We found that all the professors are aware of the AI tools and that most students will use them, whether they are instructed to do so or not. Many professors support the idea that AI tools must be included in programming courses, although some still believe these tools should not be used. Most professors think that basic programming should be taught to students of all majors, and they are concerned about ethical issues related to the use of AI tools. Most of the professors who answered the survey agree that the AI tool should be used as a support tool, never as the main tool in programming courses, and they also state that these tools must be used after having a solid knowledge of the programming fundamentals.***

Keywords-- Generative AI, programming courses, professors' perspective; educational innovation; higher education.

I. Introduction

In recent years, the advent of Artificial Intelligence tools like ChatGPT, released in November 2022, has triggered concerns among educators all over the world. Particularly, Computer Science professors are worried about how to ensure that students genuinely develop the necessary programming skills, even when using AI tools that can solve and explain the exercises meant to develop those skills. The main concern is that students' overreliance on Generative AI (GenAI) tools can inhibit genuine learning.

Professors are also concerned about whether students will need to develop real programming skills in the future, given that GenAI tools can do most of the work. They question if teaching should shift from providing students with a basic understanding to using GenAI tools for necessary programming [1]. Sheard and Denny, in their survey, found that professors are concerned about what to teach in the age of AI, given that the programming jobs are very likely to change. They also wonder if all computing students will need low-level programming skills in the future [2].

On the other hand, professors have also been adapting their way of working by using GenAI tools to enhance their lesson materials, prepare class exercises, and deepen their own understanding of the subjects they teach.

In this paper, our goal is to understand the opinions of undergraduate professors at our university regarding the relevance of using GenAI tools at different stages of the programming teaching-learning process. We asked for their perspectives on whether students should use AI in their programming courses and, if so, at which levels. Additionally, we aim to gather their opinions on whether professors should use AI to create teaching materials.

The following sections are organized as follows: Section II includes a description of the state of the art; in Section III, we describe the survey and the methodology; Section IV contains the description of the results and contrasts some of the findings with other authors' opinions; and, in Section V, we present the conclusions of this work

II. State of the Art

Since the advent of ChatGPT, numerous papers have emerged discussing how AI tools are modifying the way basic programming courses should be taught. The integration of AI tools in education has provoked a significant debate among educators.

One fact to consider is that AI models perform at least as well as most students on introductory-level programming tasks, according to Prather et al. [3]. Ibrahim and Asim [4] conducted an experiment in an introductory programming course where they mixed student and ChatGPT solutions to assignments and asked teaching assistants and professors to grade them without knowing the origin of the solutions. They showed that, in this case, the average grade for student answers was 80%, while the average grade for ChatGPT's answers was 90%. Also, Alves and Cipriano [5] mention that these tools can generate code to solve assignments and achieve high marks.

Another fact to consider is that students will use AI tools whether they are instructed to use them or not. Alves and Cipriano [5] found in a survey that students often turn to these AI tools due to their perceived effectiveness, with a majority (84.6%) using them when directed and a significant portion (69.2%) doing so even without explicit instructions. In another work, a survey conducted by Md. Mostafizer Rahman and Yutaka Watanobe [6] included the question "Have you taken help/support from ChatGPT for solving programming problems?" and 78.8% of the students answered "Yes".

Furthermore, the literature mentions both concerns and benefits.

On the concern side, professors are worried about students not being able to develop their programming skills. Prather et al. [3] found that the most common concern among professors was that students become overly reliant on using GenAI tools to generate and debug code. This concern was also expressed in the work of Sheard and Denny [2], who conducted interviews with professors from Australia, Finland, and New Zealand. In their paper, they state that excessive reliance on GenAI tools in introductory programming classes can prevent students from learning fundamental programming skills, leaving them ill-prepared for more advanced courses that involve complex tasks that GenAI tools cannot solve. Lehmann, Cornelius, and Sting [7] conducted exercises with students and found that Large Language Models (LLMs) can inhibit learning when students use them solely to ask for solutions to exercises; they also found that LLMs can lead to a self-overestimation of learning progress. Alves and Cipriano [5] found that for first-year students, over-reliance on GenAI tools like ChatGPT and Copilot can obstruct the development of foundational programming skills. They mention that students, especially beginners, struggle to understand and effectively use the generated solutions, raising concerns about students' ability to critically assess and understand AI-generated content, potentially leading to an overestimation of their capabilities. The ITiCSE 2024 working group[8], after a systematic review and survey, also state that professors are concerned about the lack of development of basic programming skills, inadequate learning, students believing they have understood the topics when they have not, and students wasting time trying to understand and fix pieces of code or ideas provided by AI tools that are not accurate.

In some of the papers where professors' opinions were surveyed, there are professors emphasizing exams or banning AI tools [8], recommending focusing on the programming process rather than solely on the final submitted work to assess students' work [2], and there is a trend toward emphasizing individual assessments, such as exams, and reducing the grade weighting on unsupervised assessments [3].

There is a concern among professors who believe that teaching basic programming might not be necessary for all students. They argue that GenAI tools can perform these tasks, as stated by Sheard and Denny [2], who found that some professors suggest a possible transition of computer science from a common academic field to a specialized area of deep expertise. Additionally, Kwubeghari [1] discusses a re-evaluation of current teaching methods, emphasizing the need for educators to shift focus from basic programming understanding to effectively using AI tools.

Another important concern is ethical issues, where students might use AI tools to complete assignments instead of learning the concepts themselves, which implies a decrease in critical thinking skills; this academic dishonesty behavior is mentioned in [1, 3, 4, 8, 9]. There is also another concern related to equity, where students might have advantages over others because of the use of paid AI subscriptions [9].

On the benefits side, Sheard and Denny [2] found that AI tools have shown promise in generating high-quality resources for students to learn. In the work conducted by Lehmann, Cornelius, and Sting [7], exercises with students found that GenAI tools enhance learning outcomes when students use them to ask for explanations. Mahon, Namee, and Becker [9] conducted a systematic review of literature regarding professors' opinions on integrating GenAI tools into introductory programming courses. On the benefits side, they found that some instructors see GenAI as beneficial for tasks like debugging, generating test data, and understanding code. Proponents argue that GenAI prepares students for future careers and maintains institutional competitiveness. Kwubeghari's [1] work gathers perspectives from teachers; on the opportunities side, they stated that AI tools can enhance learning by providing assistance and generating diverse exercises for students. In 2024, the ITiCSE working group found positive aspects mentioned by teachers in a survey about students being able to deliver more complex and higher-quality projects and using AI tools as tutors to ask for explanations and help find programming errors [8].

As can be seen, the results of educational experiences evaluating the impact of GenAI on the teaching-learning process vary. While some studies highlight the potential for learning gains and improved outcomes when AI tools are used appropriately, others raise significant concerns about students' over-reliance on these tools, which can hinder the development of fundamental programming skills. To effectively integrate AI into programming education, it is crucial to balance these perspectives, ensuring that students develop core skills while leveraging AI for advanced tasks. By gathering and addressing the concerns and recommendations from educators, institutions can better manage the integration of AI tools, by trying to identify the key points to address that may be decelerating the efforts and to boost those elements that have been shown to add value to the process.

III. Methodology

In order to answer the question about how to teach programming in the AI era, we developed a survey containing 23 multiple-choice questions and one open-ended question to gather professors' comments about their perception of how to integrate artificial intelligence into programming courses. This survey was reviewed and validated by four undergraduate academic directors and four professors related to the computer science and software engineering areas; their comments were considered to adjust it.

The survey was uploaded to a Microsoft form and then was sent to academic department directors to be distributed by email to more than 300 professors teaching programming-related courses. There was no time limit to answering it, and it was available for three weeks during which it was answered by 129 professors.

The respondents' age ranged from 25 to 68 years, with a mean age of 46.44 years and 90% of the professors' ages were between 31 and 63 years.

Among the respondents, 30% were women and 66% men; for the other 4% of respondents, we could not retrieve demographic data.

On average, the professors had 19.6 semesters of teaching experience, with 60% of the professors having between 0 and 7 semesters of teaching experience and the remaining professors having more than 7 semesters of experience.

This research was conducted at a private university in Mexico during the fall semester of 2025.

IV. Results and Discussion

The first four questions explored professors' views on whether different types of programs should include a basic programming course. Four types of programs were included: Computer Science programs, Engineering programs, Science programs, and Other types of programs (like business or social science programs). Only one option could be chosen for each question. Fig. 1 shows the results for this question.

For the same set of programs, questions 5 to 8 explore the professors' perspective about the moment in the curriculum to include AI for different programs. Only one option could be chosen for each question. Fig. 2 shows the results for these questions.

The first interesting element revealed by these responses is that, despite AI offering tools that greatly facilitate the programming process, professors consider a basic programming course essential, even in programs unrelated to the discipline. The perspective that emerges throughout the survey is that this course is not necessary for its ability to develop programming skills, but rather because it supports the development of algorithmic thinking as a problem-solving tool—an important skill in any field.

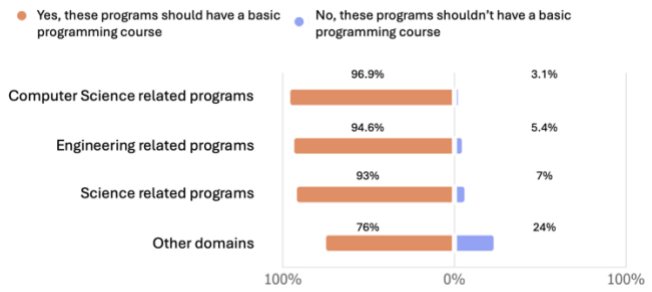

Fig. 1 Professors' perspectives about the existence of a basic programming course in different programs.

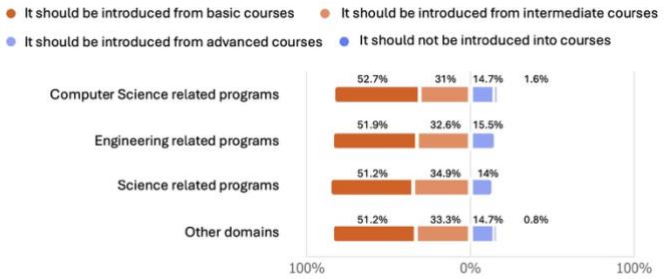

Fig. 2 Professors' perspectives about the instroduction of AI in the curriculum of diffresent programs.

Additionally, the majority opinion on including AI from basic or intermediate courses may stem from professors' recognition that modern teaching methods can support learning, motivation, and/or engagement (which aligns with [10]). However, the responses to the other questions do not show a consensus on how to introduce AI into courses or the curriculum, suggesting the need for institutional intervention to clarify this process.

Furthermore, these results contrast with those found in [11] who, at the time, found that only 43% of professors expressed acceptance of AI in education. In the present study, there no longer seems to be a doubt about whether or not it should be integrated; rather, the doubt has shifted to knowing when and how it can be integrated. This possible change may be due to the fact that the amount of information that has been published on the subject has been sufficient to gradually clarify the issue.

Question 9 asked to define who the main actor should be using the AI in the teaching-learning process. Options for this question were Students, Professors, Both or AI should not be integrated to this process. Only one option could be chosen for this question. Results can be seen in Fig. 3.

Question 10 asked if AI should be used as a main or an additional supporting tool in programming courses; only one option could be chosen for this question, and results can be seen in Fig. 4.

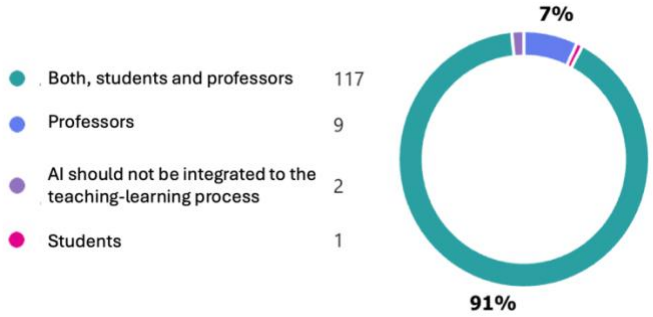

Fig. 3 Professors' perspectives about who should be the main actor using the AI in the teaching-learning process.

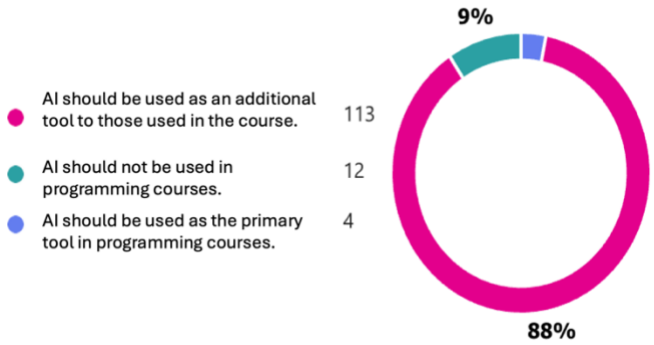

Fig. 4 Professors' perspectives about the type of tool (main or supporting) should be the AI in programming courses.

Regarding the fears and reservations that professors have about the use of AI, it is observed, in these first questions and supported by their comments, that they believe introducing AI into basic programming courses can be counterproductive, preventing students from assimilating fundamental concepts and thus using the technology as a "crutch" without fully developing their competence. This contrasts sharply with the findings of [11], who indicate that 58% of the participants in the study expressed that AI could foster permanent learning. This contrast may be due to the fact that the professors in this study indicate that AI cannot be the main tool of the course but should be an additional support tool that complements the instructional design and other elements and activities. This perception is relevant for continuing to focus on ways to integrate technology into education, given that the boom in AI has clouded this vision and given a false image that it should or can be used for everything and in any way.

Question 11 asked professors to select one or more elements that could be improved by artificial intelligence. The options were learning, motivation, or participation. Multiple options can be selected. Additionally, professors could select other elements. They could also select an option indicating that AI did not improve any aspect of the teaching-learning process. Results can be seen in Fig 5.

These results differ from the findings of [12], who suggest that AI most strongly enhances student engagement and motivation rather than participation. Notably, in that study, learning does not emerge as an isolated factor scaffolded by AI, but instead appears interlaced with elements such as interaction, participation, and engagement. A similar perspective may be reflected in our results, as the response options showed relatively similar frequencies, which could indicate that learning is perceived as being supported by attitudinal and personal elements in the educational approach.

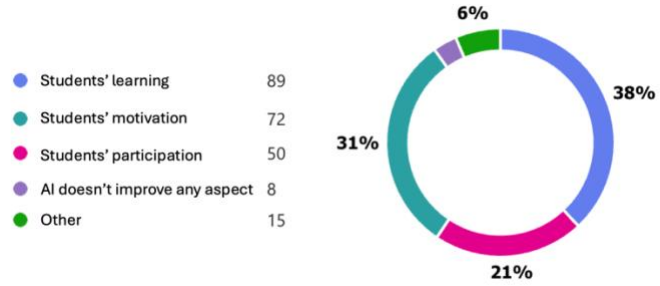

Fig. 5 Professors' perspectives about the elements that are improved by the integration of AI in programming courses.

Questions 12 to 18 were oriented to know the types of use that professors were expecting students to apply to AI and where this use should appear in the curriculum. The types of use were "to solve class exercises", "to solve exercises at home", "to solve homework", "to solve practical problems", "to solve exams", or "to solve challenges" as in Challenge Based Learning. Places in the curriculum options were "starting with basic courses", "starting with intermediate courses", or "only in advanced courses". Only one option per question could be selected. Results for these questions can be seen in Fig. 6.

Despite their modest distribution, the responses to these seven questions generally demonstrate an acceptance of AI as a support tool in most of the activities typically carried out in courses. This may be a consequence of the participants' backgrounds, given that they were professors with expertise in computer science and software engineering. Their experience and knowledge, as indicated by [13] and [14], may be the driving force behind the adoption of AI in education. Therefore, it is important to conduct studies in other disciplines to determine whether these perspectives can be generalized.

Professors consider that the only activity in which AI should not be integrated is exams. This may be due to two elements. First, exams, as summative assessment tools, are designed to measure students' mastery of competencies without external support. From this perspective, the use of AI could blur the distinction between what students genuinely know and what is generated by the tool. Second, professors express concerns about the reliability and accuracy of AI, as well as the risk of students becoming overly dependent on it. Taken together, these concerns suggest that integrating AI into summative assessments could compromise the validity of evaluating students' learning, a finding that aligns with the research of [15].

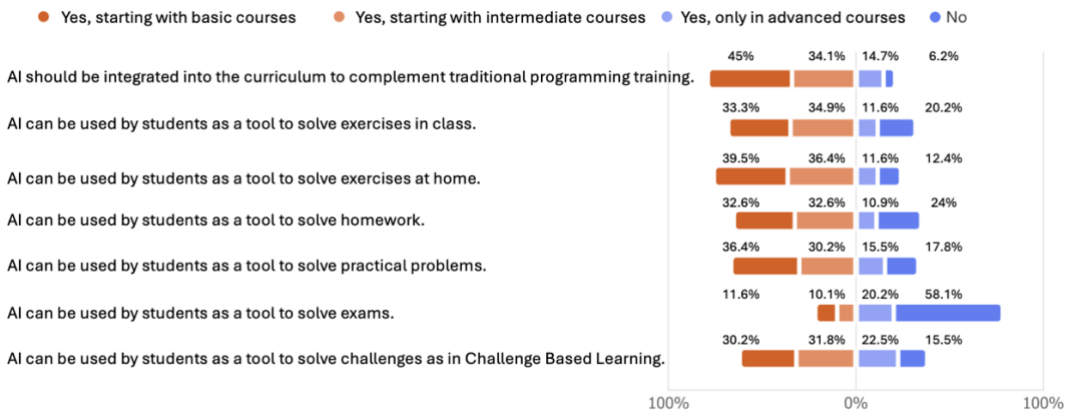

Fig. 6 Professors' perspectives about what type of use students should apply to AI and where in the curriculum this use should appear.

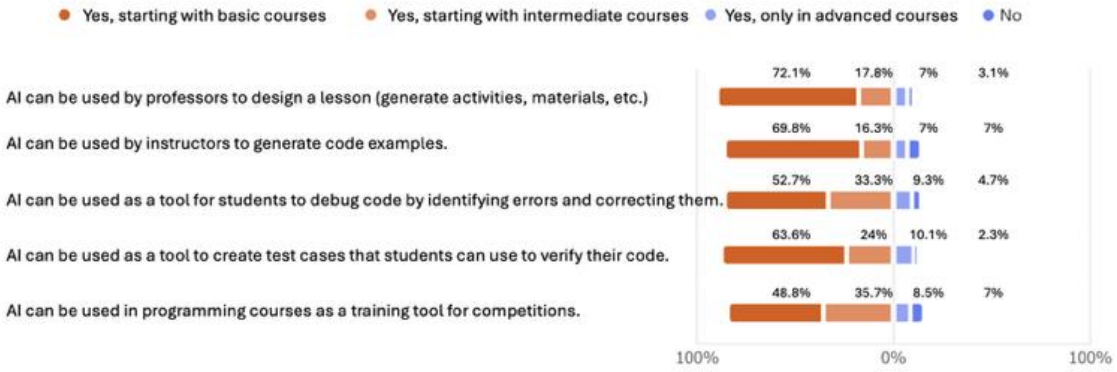

Fig. 7 Professors' perspectives about what type of use professors should apply to AI and where in the curriculum this use should appear.

On the other hand, professors may also consider their presence essential during this process to deliver an effective assessment that includes the three elements defined by [16]: feed up (where am I going?), feed back (what have I achieved?), and feed forward (what's next). AI could not perform this task adequately, and this is where it becomes clear that this technology could not replace professors, which aligns with the findings of [17].

The last 5 questions were about the uses applied by professors to AI. Questions were "to design a class", "to generate code examples", "as a debugging tool", "to create test cases", or "as a training tool for competitions". Places in the curriculum options were "starting with basic courses", "starting with intermediate courses", or "only in advanced courses". Only one option per question could be selected. Results for these questions can be seen in Fig. 7.

Regarding the open question for comments, ~63% (81) of professors left a comment. These comments were initially classified as negative (13%), neutral (38%), and positive (49%) regarding the idea of integrating artificial intelligence into programming courses.

Additionally, the comments were classified into the following five categories:

- AI as a complementary tool, not a substitute (26%). Comments indicating that AI should be an additional support to the strategies and tools deployed in a course. Furthermore, comments indicate that AI cannot be used as a substitute for any element of a class.
- Develop the fundamentals before using AI (29%). Comments stating that AI can or should be used after students have acquired the fundamentals.
- Importance of critical thinking (18%). Comments expressing a need for students to develop skills and strategies that allow them to identify errors in the responses provided by AI.
- Integrity and ethics in the use of AI (17%). Comments expressing a need for students to develop tools and strategies that promote the integral and ethical use of AI.
- Impact of AI on industry and education (4%). Comments recognizing the transformation that AI is causing in industry and education.

In addition to these five categories, a sixth category is included for empty comments (examples: “NA”, “-”, “.”) (6%).

Results for this categorization can be consulted in Fig. 8.

As can be seen in the responses to the multiple-choice questions, and as highlighted in the open-ended comments, there is a broad openness to integrating AI into the teaching-learning process. However, a reservation is consistently observed regarding potential issues of academic integrity and insufficient skills development among students, coinciding with [5, 7, 12]. The comments also reveal a need for professor training on these topics and, in some cases, the need to explicitly integrate the ethical use of AI into the curriculum.

Another interesting element repeatedly observed in the open comments is the acceptance that AI is transforming education and needs to be considered a component of curricula. This aligns with [10] who indicate that curricula must keep pace with technological advancements, as their inclusion in courses can support the achievement of learning objectives.

Finally, comparing Fig. 6 and Fig. 7, it can be observed that professors show greater acceptance of using AI themselves compared to acceptance of students' use. Furthermore, it is observed that professors’ use of AI is quite accepted even at the introductory level. This may be because professors see the usefulness and time savings in their teaching work, which coincides with [10] and [11]. Additionally, in the comments, professors suggest that students' maturity is a significant obstacle for them to use AI appropriately. They also emphasize the need for courses or training to develop the necessary skills to guide students in this area to diminish this barrier.

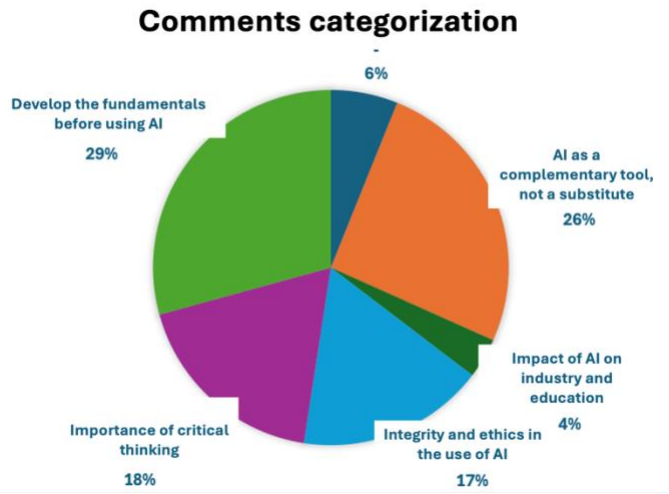

Fig. 8 Comments categorization.

As can be seen throughout the responses to all the questions, professors no longer show a high degree of rejection of AI, nor are there explicit or frequent mentions of dangers or fears about the possible replacement of their work by technology. However, expressions about the potential effects on classroom dynamics and their role as professors are still found, as observed by works like [18] or [19]. This highlights the need for institutions to create professors’ development programs to address these new needs in the context of AI, ranging from the use of technology and teaching strategies to ethical considerations.

However, despite the high level of acceptance shown by teachers, further studies are needed to determine whether this translates into practical implementations, as noted by [14]. The perception of AI's usefulness and its potential integration into curricula is evolving, moving beyond the almost universal rejection. Nevertheless, action is needed to leverage the advantages of technology in education that teachers are observing and to identify any potential limitations.

In this sense, [20] defines 5 components to take into account to integrate AI into education:

1. obstacles and facilitators of participation in teaching AI,
2. interactive design thinking processes,
3. teachers’ knowledge of teaching AI,
4. orienting AI knowledge for social good,
5. the holistic understanding of teaching AI.

The findings in this work contribute to specifying point 5 by clearly defining that the usefulness of AI should be observed in accelerating tasks that require basic, fundamental, or low-complexity cognitive skills, allowing effort to be concentrated on developing higher-level, more complex, or broader skills. However, to achieve this, this delegation should not be carried out until students have developed a minimum level of basic skills. This is because complex skills require a solid understanding of the fundamentals, which will allow for better generalization of solutions at higher levels of complexity.

From this perspective, and in the context of this study, the concept of teaching the use of AI falls short, giving way to the concept of teaching problem-solving supported by AI tools.

The results in this study can also be analyzed from the perspective of the Technology Acceptance Model (TAM) [21]. For example, perceived usefulness is presented as the most important factor significantly influencing activity toward the use of AI [22]. In this study, it is observed that professors show a very positive attitude toward the use of AI, which is a central element for its adoption in the classroom.

Professors also express concern about potential deskilling in students. However, [22] indicates that this variable does not have a significant effect on attitudes toward AI. On the contrary, it suggests that the belief that AI enhances individual capabilities has a strong influence on AI adoption. Given this, and given that this study found that professors have this mindset, we are facing a unique opportunity that, combined with elements of metacognitive and motivational skills development in students, could result in greater and more effective AI adoption in the classroom, as indicated by [23].

On the other hand, [24] indicates that the relationships between TAM components depend on the context, so it is important that educational institutions design contextualized strategies that consider the specific characteristics of their

professors and students to achieve an effective integration of AI.

V. Conclusions

In this paper we present the results of a survey applied to 129 Software Engineering and Computer Science professors in a private Mexican university.

We found that professors are aware of generative AI and how it influences the teaching-learning process. They understand the need to integrate it in classes as a support tool and not as the main tool used to learn.

The results also show that professors believe students should first develop fundamental programming skills before using AI tools. This suggests that professors need to design clear guidelines for students about when and how to use AI in each course; since each course might have different needs.

However, some nervousness is evident, which seems to come from a lack of knowledge of a strategy or methodology for integrating AI into the teaching-learning process. This comes from:

1. The level of development of teaching skills related to AI.
2. The unknown maturity of students to use a tool with so much potential.
3. The ethics and academic integrity issues related to this integration.

Therefore, educational institutions need, in addition to creating pathways that allow the development of AI-related skills in teachers, to take the next step and create spaces to research and develop guides that describe best practices and recommendations for integrating different types of tools into different types of courses; including not only technical aspects but also ethical and responsible use.

Future research could also include professors from other universities to validate findings and to identify new curricular actions that could strengthen programming education in the AI era.

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