Educación XX1
ISSN: 1139-613X · e-ISSN: 2174-5374

Primary school teachers' attitudes toward visual block programming: differences by sex and age

Actitudes de los docentes de primaria hacia la programación visual por bloques: diferencias por sexo y edad

Ana González-Cervera [1,2*]
Olga Martín-Carrasquilla [1,2]
Yolanda González-Arechavala [1,2,3]

[1] Universidad Pontificia de Comillas, Spain
[2] Cátedra para la promoción de la mujer en vocaciones STEM en la Formación Profesional para la Movilidad Sostenible, Universidad Pontificia Comillas, Spain
[3] Instituto de Investigación Tecnológica, Universidad Pontificia Comillas, Spain
* Corresponding Author. E-mail: amgonzalez@comillas.edu

How to reference this article:

González-Cervera, A., Martín-Carrasquilla, O., & González-Arechavala, Y. (2026). Primary school teachers' attitudes toward visual block programming: differences by sex and age. *Educación XX1*, *29*(1), 177-197. https://doi.org/10.5944/educxx1.42387

Date received: 18/09/2024
Date accepted: 28/02/2025
Published online: 15/01/2026

ABSTRACT

In the current era of artificial intelligence, the teaching of programming has become more relevant in the primary school primary curriculum, especially through Visual Block Programming as a tool for developing Computational Thinking. This study analyses the attitudes of primary school teachers towards Visual Block Programming and examines possible differences according to sex and age. The research adopted a non-experimental cross-sectional design with a quantitative approach. A scale with three dimensions (Self-efficacy, Relevance, and Interest) was applied, and its structure was confirmed through a Confirmatory Factor Analysis. The sample consisted of 492 primary school teachers in Spain. Descriptive analyses and statistical tests such as Student's t-test, one-way ANOVA and Pearson's correlation were used, using IBM SPSS and Jamovi for data processing. When parametric assumptions were not met, non-parametric methods were applied. The results indicate that primary school teachers show a moderate overall attitude towards Visual Block Programming (3.18), with high perceived relevance (3.65) and interest (3.33), but low self-efficacy (2.54). Male teachers have significantly higher self-efficacy than their female counterparts, although both sexes share the perception of the educational value of Visual Block Programming. In addition, younger teachers (22-30 years) show greater confidence in their ability to teach it, while age does not influence relevance and interest. These findings underline the need to implement differentiated training programmes that reinforce self-efficacy in older teachers and reduce the sex gap, promoting a more inclusive and effective integration of Visual Block Programming in primary education.

Keywords: teacher attitudes, elementary school teachers, programming, computational thinking, gender differences, age differences

RESUMEN

En la era actual de la inteligencia artificial, la enseñanza de la programación ha cobrado una mayor relevancia en el currículo educativo de Primaria, especialmente a través de la Programación Visual por Bloques como herramienta para desarrollar el Pensamiento Computacional. Este estudio analiza las actitudes de los docentes de Primaria hacia la Programación Visual por Bloques y examina posibles diferencias según sexo y edad. La investigación adoptó un diseño transversal no experimental con enfoque cuantitativo. Se aplicó una escala con tres dimensiones (Autoeficacia, Relevancia e Interés), cuya estructura fue confirmada mediante un análisis factorial confirmatorio. La muestra estuvo compuesta por 492 docentes de Educación Primaria en España. Se emplearon análisis descriptivos y pruebas estadísticas como t de Student, ANOVA unidireccional y correlación de Pearson, utilizando IBM SPSS y Jamovi para el procesamiento de datos. Cuando no se cumplieron los supuestos paramétricos, se aplicaron métodos no paramétricos. Los resultados indican que los docentes de Primaria muestran una actitud total moderada hacia la Programación Visual por Bloques (3.18), con alta percepción de relevancia (3.65) e interés (3.33), pero baja autoeficacia (2.54). Los docentes varones presentan una autoeficacia significativamente

mayor que sus compañeras, aunque ambos sexos comparten la percepción del valor educativo de la Programación Visual por Bloques. Además, los docentes más jóvenes (22-30 años) muestran mayor confianza en su capacidad para enseñarla, mientras que la edad no influye en la relevancia e interés. Estos hallazgos subrayan la necesidad de implementar programas de formación diferenciados que refuercen la autoeficacia en docentes mayores y reduzcan la brecha de sexo, promoviendo una integración más inclusiva y efectiva de la Programación Visual por Bloques en la Educación Primaria.

Palabras clave: actitud del profesor, enseñanza primaria, programación, pensamiento computacional, diferencia de sexo, diferencia de edad

INTRODUCTION

In the current era of artificial intelligence, programming education has gained increasing attention. It has been gradually integrated into the educational curriculum (Bocconi et al., 2022) to develop students' computational thinking (CT) skills.

CT, popularised by Wing (2006) and initially developed by Papert (1980), is the cognitive skill that occurs when formulating and searching for a solution to a problem, such that both a person and a machine can understand and execute the problem.

The most commonly used strategies to develop CT in Primary Education are Visual Block Programming (VBP) and robotics (Jiang & Li, 2021; Kiliç, 2022; Ortuño & Serrano, 2024). VBP allows students to get started in computing in a simple way, using a programming language that uses graphical elements, which is much more intuitive than professional programming languages. In VBP, programs are created by choosing, dragging and arranging graphical blocks in a window representing basic code structures, facilitating an intuitive understanding of computational concepts. This tool develops CT, which involves logical analysis, data organisation, modelling and identifying solutions to complex problems (Román-González et al., 2017).

The relevance of CT and programming in the educational sphere has prompted various research projects focused on their integration from the earliest stages of education. Countries such as Finland, the United States, South Korea and China have implemented advanced policies to integrate CT and programming into their educational curricula, obtaining significant results in students' cognitive development and teacher training (Acosta, 2021; Sun & Zhou, 2023).

For example, Finland is a leader in integrating CT into its national curriculum (Finnish National Agency of Education, 2016). Since 2016, programming and CT have been an integral part of basic education, including them as cross-curricular elements in all subjects. On the other hand, in the United States, formal and informal programming education has been widely promoted from age 5 to 18 (K-12 Computer Science Framework, 2016). On the other hand, South Korea has promoted

the use of robotic technologies in various sectors, including education, as part of its technology development strategy (Jung et al., 2023). In China, implementing VBP, such as Scratch and educational robotics, has improved students' collaborative and cognitive skills (Sun & Zhou, 2023). Similarly, programmes such as Code.org are effective in fostering skills such as critical reasoning and problem solving from the early school years, while helping to reduce gender gaps in programming (Sun & Liu, 2024).

In the national context, studies have been conducted that address the competences and educational strategies necessary for their development with a focus on gender equity (Espino & González, 2015). In addition, the study by Román-González et al. (2017), which was conducted with primary and secondary students, showed statistically significant correlations between CT and logical reasoning, spatial ability, and complex problem solving. These experiences highlight how CT and programming foster skills such as logical reasoning, problem solving and creativity from an early age, aspects that the Organic Law for the Modification of the Organic Law on Education (LOMLOE) also seeks to promote in Spain (BOE, 2020).

Effective programming education that develops students' CT requires teachers to be well prepared, not only in terms of technical skills, but also in their willingness and attitude towards these competencies (Sun & Zhou, 2023). Attitudes towards programming and CT are complex and multidimensional constructs, the theoretical delineation of which has not yet reached a consensus on its constituent elements. This lack of agreement has led to multiple definitions and approaches that reflect the variability of dimensions that make up these attitudes. Different studies have examined attitudes towards programming and CT considering various dimensions, such as self-efficacy, interest, usefulness, relevance, or value beliefs in teaching programming, among others (Rich et al., 2020; Sun & Zhou, 2023; Sun & Liu, 2024). The scale used in this study has three dimensions: self-efficacy, relevance, and interest, which were chosen after the validation process explained in the method section.

Self-efficacy towards programming

Self-efficacy is defined as 'each individual's judgments about his or her abilities, based on which he or she will organise and execute his or her actions in such a way as to achieve the desired performance' (Bandura, 1987, p. 416). In the field of programming, self-efficacy refers to the teacher's confidence in his or her ability to teach fundamental programming concepts, resolve students' doubts, correct errors and learn autonomously about the subject matter (Authors, 2024).

According to the study by Wijnen et al. (2024), teacher self-efficacy is a determining factor in adopting new technologies in the classroom. Those with higher self-efficacy are more willing to use them, while those with less confidence tend to avoid their integration. Although the study does not focus specifically on VBP, these findings could be extrapolated to different technological tools used in teaching.

Low self-efficacy generates significant levels of anxiety and distrust in teachers in relation to teaching programming, thus affecting educational quality (Jaipal-Jamani & Angeli, 2017; Rich et al., 2019). This problem highlights the need to implement teacher training programmes aimed at strengthening self-efficacy through practical experiences and the application of active methodologies, which would improve teachers' confidence and their ability to integrate programming into the classroom effectively (Mason & Rich, 2019).

Relevance towards programming

While teacher self-efficacy plays a key role in implementing scheduling in the classroom, perceived relevance is equally crucial. While self-efficacy refers to a teacher's confidence in his or her ability to teach programming, perceived relevance relates to the subjective valuation teachers give to programming regarding its impact on CT development and student motivation (Fang, 1996; Rich et al., 2020). As Rich et al. (2020) point out, a teacher may recognise the importance of teaching programming without necessarily feeling empowered to do so effectively.

According to Fang (1996), teachers' beliefs about the importance of a subject influence their decisions and how they teach it. This suggests that teachers who perceive programming as relevant to student learning will be more inclined to integrate it into their teaching practices.

Several studies have shown that relevance significantly influences teachers' willingness to implement scheduling in the classroom (Mason & Rich, 2019).

Interest in programming

Teacher interest in VBP is a determining factor for its successful implementation in the classroom. It is related to the teacher's willingness to explore, learn and apply VBP in their educational practice. According to Bandura (1987), interest influences commitment to learning challenges and persistence in difficulties.

Several studies have indicated that teacher interest is related to self-efficacy and perceived relevance (García-Ruiz et al., 2023). Teachers with a high level of interest tend to adopt innovative methodologies and seek professional development

opportunities (Hestness et al., 2018; Marcelino et al., 2018). However, lack of time and lack of accessible training resources can be barriers to teachers' interest (Bocconi et al., 2022).

Influence of gender and age on attitudes towards VBP

Different studies have identified that personal factors, such as gender and age, influence teachers' attitudes towards programming. Pérez-Calderon et al. (2021) concluded that digital competence was higher in younger teachers or students in education degrees than older ones. Similarly, Sun and Zhou (2023) highlight that male teachers and those under 30 have more positive attitudes towards programming than their older or female colleagues. These results suggest that gender and age differences are relevant when analysing how new educational technologies are adopted in the classroom, highlighting the importance of understanding these variables in primary school teachers.

In this sense, Kiliç (2022) identified gender as a determining factor in developing CT-related skills, observing a general tendency for men to have more favourable attitudes. This phenomenon can be explained by cultural, family and educational factors that affect women's motivation towards programming. These factors include the lack of female role models in the technological field, gender stereotypes and socio-cultural expectations, as well as differences in perceived self-efficacy and the influence of teachers in their early stages of training (Liu et al., 2021; UNESCO, 2019).

However, the literature is inconclusive on the relationship between gender and age with teaching programming. Negrini (2020) and Piedade (2021) found no significant differences in some educational contexts, highlighting the need for more specific studies in Primary Education. The paucity of empirical evidence on these variables limits the implementation of effective teacher education strategies. It leaves the question of the extent to which they influence the adoption of VBP.

Given that the teaching of scheduling depends not only on technical factors, but also on teachers' self-efficacy, relevance and interest, it is crucial to explore how these aspects vary according to the demographic profile of teachers (Liu et al., 2021; García-Ruiz et al., 2023). Analysing these relationships will enable the design of more effective training programmes tailored to teacher characteristics, facilitating a more equitable and effective implementation of CT and programming in the classroom.

To meet the requirements proposed by the LOMLOE (BOE, 2020) for Primary Education regarding the development of CT, it has been decided to measure attitudes towards VBP, as it is the most widely used strategy according to the systematic

review by Ortuño and Serrano (2024). The study aims to determine whether primary school teachers show significant variations in their attitudes towards VBP according to gender and age. The following hypotheses are proposed:

Hypothesis 1: There are significant differences in attitudes towards VBP and its dimensions according to teachers' gender.

Hypothesis 2: There are significant differences in attitudes towards VBP and its dimensions according to teachers' age groups.

Hypothesis 3: There are significant differences in attitudes towards VBP and teachers' self-efficacy due to the interaction effect between gender and age.

METHOD

The research was carried out using a non-experimental cross-sectional design, with a quantitative methodology consistent with the objective and hypotheses stated. This approach is suitable for describing and comparing attitudes towards VBP between different groups (gender and age), prioritising the analysis of differences rather than the establishment of causal relationships.

Participants

Prior to this research, and with the aim of validating the scale designed to measure primary school teachers' attitudes towards VBP as a resource for developing CT, the scale was applied to two different samples of primary school teachers in Spain at two different times. The first sample, composed of 202 teachers, was used to perform the Exploratory Factor Analysis (EFA). In contrast, the second, composed of 492 primary school teachers in Spain, was used to apply the Confirmatory Factor Analysis (CFA). For this study, the analyses were performed with the data from the second sample presented in Table 1 due to methodological criteria of representativeness and generalisable validity of the results, since it was with this sample that the CFA was applied. This approach ensures that the interpretations are supported by data obtained after debugging and validation of the instrument. It makes it possible to test the hypotheses generated in the CFA, improving external validity and minimising the risk of overfitting the results.

Table 1
Sample characteristics

Sex		Age				Years of teaching experience			Type of school		
Men	Women	M	SD	Min	Max	0-10	11-25	>de 25	Public	Semi-private	Private
31.3%	68.1%	39.8	10.6	22	66	44.1%	39.6%	16.3%	13.8%	74.2%	12.0%

A Note. % up to 100% in sex correspond to "I prefer not to answer".
B Note. The gender distribution in the sample reflects the general trend of the study population, according to the Ministry of Education, Vocational Training and Sports (MEFD, 2024), where in the 2020-21 academic year, 82.2% of primary school teachers were female. However, this study's proportion of female participants (68.1%) is lower, possibly due to sampling and voluntary participation.

Instruments

For this research, a scale on attitudes towards VBP in primary school teachers was designed and validated using multiple validation strategies. The literature review identified a previous scale for this context (Rich et al., 2020), which did not cover all relevant aspects, justifying the development of a new instrument.

Content validity was ensured using the Delphi method (Authors, 2024). Items that met at least four criteria were eliminated after two consecutive rounds: mean less than 4, standard deviation greater than 1.5, coefficient of variation greater than 25%, Aiken's V value less than .70, or request for exclusion by two or more experts. Subsequently, an AFE was performed, which revealed a three-dimensional structure: Self-efficacy, Relevance, and Interest. Then, a CFA confirmed this structure, showing satisfactory fit indices (CFI = .964, TLI = .955, SRMR = .0721, RMSEA = .0748).

The final version of the scale consists of 14 items (Annexe 1) and presents high internal consistency (Cronbach's Alpha = .916; McDonald's Omega = .921), which supports its reliability and validity as an instrument to assess attitudes toward VBP.

The scale is a five-point Likert-type scale, ranging from "Strongly Disagree" to "Strongly Agree." The final instrument included, in addition to this scale, questions on sociodemographic data (sex, age, teaching experience and type of school) and a question on the perception of the level of knowledge of VBP.

Procedure

The study followed the ethical principles established by the Declaration of Helsinki (2017) and the Organic Law 3/2018 on Personal Data Protection and

Guarantee of Digital Rights (BOE, 2018). Participants were informed about the study's aims, and their informed consent was requested. Responses were collected anonymously, ensuring the confidentiality of their identity.

The sample was selected by non-probability convenience sampling, using networks of schools known to the research team, thus facilitating the recruitment of primary school teachers. Social networks such as Facebook and LinkedIn were also used. Schools were contacted directly to distribute the questionnaire among their teaching staff and individual primary school teachers.

The questionnaire application process was implemented through Microsoft Forms, facilitating efficient and secure data collection.

Data Analysis

The data were processed statistically with the IBM SPSS for Windows version 28.0.1.1 and Jamovi 2.3.28. The descriptive analysis of attitudes towards the VBP and each of the dimensions was carried out using frequency distributions, where the mean (M), standard deviation (SD), minimum and maximum were calculated. Using Student's t test statistics for independent samples and one-way Analysis of Variance (one-way ANOVA), the differences between Primary School teachers' attitudes towards VBP and its three dimensions were evaluated according to personal factors (gender and age). In cases where parametric assumptions were not met, non-parametric methods were calculated. In the ANOVA analyses, Scheffé's post-hoc test was used, since the samples were unequal (different N) and because this method is more conservative. To calculate differences in the interaction of gender and age variables on attitudes and self-efficacy, a univariate factorial ANOVA was calculated. In addition to descriptive and differential analyses, Pearson's correlation coefficient was calculated to explore the relationship between the variables.

RESULTS

Descriptive analysis of teachers' attitudes towards VBP

The results obtained with the sample of 492 teachers are shown in Table 2.

The mean score on primary school teachers' total attitude towards VBP is 3.18 on a scale of 1 to 5. Since the scale's midpoint is 3, this value reflects a moderate attitude towards VBP. In addition, the mean scores on the three dimensions of the scale are: Self-efficacy 2.54, Relevance 3.65 and Interest 3.33. These scores indicate a low level of self-efficacy, a moderate-high level of relevance and a moderate level of interest in VBP. The low level of self-efficacy reflects a limited confidence

in VBP and its teaching at the primary level. This result is associated with teachers' perception of their knowledge of VBP, which was assessed by an external question to the scale 'What is the level of knowledge towards VBP?' In this question, teachers indicated their perception of their level of knowledge on a scale of 1 to 5 (M=2.28). Furthermore, the relationship between self-efficacy and perceived level of knowledge is positive and significant (Pearson's R = .665, p < .001). This analysis reinforces the interpretation that higher perceived knowledge in VBP is related to higher perceived self-efficacy.

Table 2
Descriptive analysis of attitudes towards VBP and its dimensions

Dimensions	Min	Max	M	SD
Total Attitude	1.29	5.00	3.18	0.74
Relevance	1.17	5.00	3.65	0.78
Self-efficacy	1.00	5.00	2.54	1.11
Interest	1.00	5.00	3.33	0.91

After collecting the survey data, the data were analysed to test the hypotheses developed.

Gender effect on attitudes towards VBP and its dimensions

Hypothesis 1: There are significant differences in attitudes towards VBP and its dimensions according to teachers' gender.

The results obtained in this sample, see Table 3, indicate that male teachers (M = 2.83, SD = 1.16) score significantly higher than female teachers (M = 2.41, SD = 1.06) on Self-efficacy (t = 4.02, p < .01), the effect size between the two groups being substantial (Cohen's d = 1.09). However, for Total Attitude (Mann-Whitney U = 22974.5, p = .052) and the dimensions of Relevance (Mann-Whitney U = 25926.5, p = .927) and Interest (Mann-Whitney U = 25401, p = .785), no significant differences are found between males and females, despite large effect sizes.

Table 3
Gender Differences in Attitudes towards VBP and its dimensions

	Gender	N	M	DT	Contrast statistic	d
Total Attitude	Men	154	3.29	0.84	22974.5	0.74
	Women	335	3.14	0.70		
Relevance	Men	154	3.66	0.86	25401	0.79
	Women	335	3.65	0.75		
Self-efficacy	Men	154	2.84	1.16	4.02**	1.09
	Women	335	2.41	1.06		
Interest	Men	154	3.33	1.02	25926.5	0.91
	Women	335	3.33	0.86		

a Note. Since the results of Levene's test indicate that the assumptions of equality of variances are not met (p<.05) for the variables (Attitude, Relevance and Interest), the Mann-Whitney U was calculated as an alternative to Student's t-test.
b Note. *p < .05; **p < .01.

Age effect on attitudes towards VBP and its dimensions

Hypothesis 2: There are significant differences in attitudes towards VBP and its dimensions as a function of teachers' age.

A weak and statistically significant negative relationship exists between age and attitudes towards VBP (Pearson's R = -.135, p = .003). Table 4 shows that this finding is consistent with the analyses conducted, evidencing statistically significant differences between age groups (F = 3.36, p = .019), with a small effect size (η^2 = 0.02). The results show that teachers below 30 have significantly higher attitudes towards VBP than teachers between 41 and 50, with means of 3.34 and 3.07, respectively.

Similarly, when examining differences by age in the three dimensions of the scale, significant differences are found in Self-efficacy (F = 4.691, p = .003), with younger teachers (22-30 years) having higher self-efficacy towards VBP (M = 2.8) than teachers aged 41-50 years (M = 2.36) and those over 50 years (M = 2.34). However, in Relevance and Interest, no significant differences are found according to the age of the teachers.

Table 4
Age Differences in Attitudes towards VBP and its dimensions

Dimensions	Age	N	M	SD	F	Eta squared
Total Attitude	22-30	116	3.34	0.74	3.357*	.020
	31-40	148	3.22	0.75		
	41-50	147	3.07	0.66		
	> de 50	81	3.11	0.82		
Relevance	22-30	116	3.77	0.78	1.589	.010
	31-40	148	3.64	0.79		
	41-50	147	3.56	0.78		
	> de 50	81	3.65	0.80		
Self-efficacy	22-30	116	2.80	1.02	4.691*	.028
	31-40	148	2.62	1.14		
	41-50	147	2.36	1.04		
	> de 50	81	2.34	1.20		
Interest	22-30	116	3.39	0.98	0.497	.003
	31-40	148	3.35	0.87		
	41-50	147	3.33	0.87		
	> de 50	81	3.32	0.95		

Note. *p < .05

Relationship of sex and age on attitudes and self-efficacy towards VBP

Hypothesis 3: There are significant differences in attitudes toward VBP and teachers' self-efficacy due to the interaction effect between sex and age.

Although no significant interactions were found between sex and age in relation to Total Attitude (F = 0.962; p = .410) and Self-Efficacy (F = 0.351; p = .788), interesting findings were obtained. Table 5 presents the descriptive results in this sample. Gender differences in Total Attitude and Self-Efficacy are more pronounced in older teachers compared to younger ones. This suggests a narrowing of the gap between men and women in the younger generations with respect to the older ones, although these differences did not reach statistical significance.

Table 5
Descriptive analysis by teachers' sex and age

Age	Gender	N	Total Attitude		Self-efficacy	
			M	SD	M	SD
22-30 years	Men	27	3.38	0.90	3.07	1.07
	Women	88	3.34	0.68	2.74	0.99
31-40 years	Men	58	3.26	0.85	2.84	1.20
	Women	90	3.19	0.68	2.49	1.08
41-50 years	Men	47	3.26	0.77	2.73	1.12
	Women	99	2.97	0.63	2.18	0.97
> de 50	Men	22	3.35	0.90	2.75	1.28
		58	3.02	0.78	2.17	1.15

DISCUSSION AND CONCLUSIONS

The present study seeks to analyse whether primary school teachers' attitudes toward VBP vary significantly by gender and age in response to the requirements of the LOMLOE (BOE, 2020) for the promotion of CT in the early educational stages.

Overall, it is observed that the mean total attitude towards VBP of Primary teachers is moderate, lower than the medium-high level of Primary teachers in China (Sun & Zhou, 2023), which may be due to the widespread use of VBP tools such as Scratch in China. The mean scores on the scale dimensions reflect considerable relevance and interest of VBP in developing students' CT, but low self-efficacy. This discrepancy is consistent with the results of Rich et al. (2020), who reported that, although teachers consider STEM areas and programming as important as the ABCS, they do not feel prepared to teach them, possibly due to a lack of training and rapidly evolving technologies.

In this sense, a low attitude and self-efficacy towards VBP may imply a limited use by primary school teachers (Liu et al., 2021; Rich et al., 2020; Wijnen et al., 2024). Considering the results obtained, it is necessary to implement training programs to train teachers and provide adequate resources for developing CT and VBP in primary school. Therefore, future research will focus on designing, developing and evaluating these training programs and identifying effective pedagogical strategies to strengthen teachers' attitudes and knowledge in this area.

Regarding the first hypothesis, which holds gender differences in attitudes toward VBP and its dimensions, the analyses obtained indicate that male teachers have a statistically higher mean attitude toward VBP than female teachers, supporting the ideas of Kiliç (2022). In particular, this difference is significant in the self-efficacy dimension, where male teachers score higher than their female colleagues, reinforcing the findings of Sun and Zhou (2023), Sun and Liu (2024) and Villalustre and Cueli (2023).

This disparity may be related to cultural and educational factors influencing the perception of programming competence between men and women. Sun and Liu (2024) argue that sex differences in self-efficacy and attitudes toward programming may be due to the perception of computer science and programming as traditionally male fields. This stereotype may generate anxiety in female teachers when faced with programming content, negatively affecting their self-efficacy and willingness to integrate it into their teaching (Jaipal-Jamani & Angeli, 2017; Rich et al., 2019). Moreover, the lack of female role models in the programming field may reinforce this perception and decrease the confidence of female teachers (Liu et al., 2021; UNESCO, 2019). The conclusion of Young's (2013) study highlights that female teachers in STEM areas not only provide positive role models for other women but also contribute to reducing the implicit stereotype that Science and Technology are male disciplines.

On the other hand, although the results of the present study confirm the difference in self-efficacy, no significant differences were found in the dimensions of relevance and interest, which contrasts with the findings of Sun and Zhou (2023), who identified that male teachers showed a greater interest in programming than their female peers. This discrepancy suggests that while males may feel more empowered in terms of self-efficacy, the perceived educational value of programming is shared by both sexes. Sun and Liu (2024) highlight that, although female teachers may feel less confident in their ability to teach programming, they tend to show a strong commitment to its integration in the classroom when provided with adequate training and resources. This is consistent with previous studies that indicate that self-efficacy in programming may be influenced by gender stereotypes and previous technology training experiences (Vasconcelos et al., 2022), which reinforces the importance of providing educational strategies that encourage women's participation in programming (Villalustre & Cueli, 2023).

The incorporation of mentoring strategies and female role models in the field of programming (Bocconi et al., 2022) can be an effective way to minimise these differences and foster greater equity in CT teaching (UNESCO, 2019).

About the second hypothesis, the results of this study confirm that teachers' age influences their self-efficacy towards VBP, as younger teachers (22-30 years old) show greater confidence in their ability to teach and master these contents

compared to older teachers. These findings are consistent with the studies of Pérez-Calderón et al. (2021) and Sun and Zhou (2023), who found that younger teachers tend to adopt new educational technologies more readily and exhibit more positive attitudes toward programming than their older colleagues. This aligns with studies that have identified that early exposure to programming and technology influences perceptions of teacher self-efficacy over time (Villalustre & Cueli, 2023). However, no statistically significant differences were identified in the dimension of relevance and interest, suggesting that, although age may affect teachers' confidence in their ability, it does not appear to change the overall perception of the importance of VBP in the classroom. The absence of significant differences in relevance and interest suggests that the perception of the value of VBP as an educational tool is homogeneous among teachers of different ages. This reinforces the idea that, although age may be a determining factor in self-efficacy, the importance assigned to VBP in the educational curriculum is shared by teachers. In this regard, Sun and Zhou (2023) emphasise that while self-efficacy may decrease with age, teachers' overall willingness to integrate VBP is not affected to the same extent.

These results have relevant implications for developing training strategies for teachers of different age groups. As Ortuño and Serrano (2024) have pointed out, current educational policies should focus not only on the technical training of teachers but also on strengthening their self-efficacy and motivation. It is essential to design differentiated interventions in teacher training. While younger teachers may benefit from autonomous and experimental training approaches, older teachers may require structured mentoring and coaching programs to strengthen their self-efficacy and reduce potential barriers to adopting new technologies (Bocconi et al., 2022; Mason & Rich, 2019). In line with this, Pérez-Calderón et al. (2021) highlight that the gap in teacher self-efficacy can lead to inequalities in the development of CT in the classroom, which reinforces the importance of developing customised training programs according to the experience and age of teachers.

Concerning the third hypothesis, despite significant differences in the attitudes toward VBP of teachers according to sex and age separately, no significant differences are found in the interaction of both variables. However, it is noteworthy that gender differences in total attitude and self-efficacy are more pronounced in older teachers than younger ones, suggesting a possible narrowing of the gap between men and women in younger generations, although these differences did not reach statistical significance.

This study has several limitations that should be considered. First, due to its non-experimental design, it is not possible to establish causal relationships, which makes it difficult to generalise the findings. In addition, the non-probabilistic convenience sampling may affect the representativeness of the results, mainly due to the imbalance in the representation of teachers from public and private schools.

Another important limitation lies in the composition of the sample. The proportion of female participants (68.1%) is lower than that officially represented among primary school teachers in Spain (82.2%), which could be related to the voluntary sampling process. Despite having a large and heterogeneous sample of 492 teachers, it is recommended that future research adopt longitudinal or experimental designs that allow us to analyse the evolution of teaching attitudes over time and extend the scale's construct validity, considering diverse professional profiles and educational contexts.

Finally, although this study incorporates years of teaching experience in the description of the sample, its direct influence on attitudes has not been analysed. Previous studies have indicated that this variable may affect technological self-efficacy and disposition toward pedagogical innovations (Fagerlund et al., 2022), so future research should explore this aspect in greater depth.

The results of this study contribute to the debate on the relationship between personal factors (gender and age) and attitudes towards VBP, evidencing that self-efficacy is a differentiating factor. At the same time, relevance and interest remain stable among teachers. This suggests that future research should explore other contextual factors influencing teachers' willingness to integrate VBP into their pedagogical practice, such as training, access to technological resources, and institutional support (Sun & Zhou, 2023).

In this sense, teacher training plays a key role. As Ortuño and Serrano (2024) point out, CT and VBP training are still insufficient in many educational contexts, which limits their effective implementation. It is necessary to strengthen initial training and ensure continuous updating in digital methodologies and tools (Bocconi et al., 2022). Sun and Zhou (2023) also stress that access to technological resources significantly impacts teachers' predisposition towards teaching programming, as those with greater availability of devices have more favourable attitudes. However, this access is not equitable, leading to inequalities in integrating CT in schools.

Institutional support is also crucial for the implementation of classroom programming. Sun and Zhou (2023) note that teachers are more willing to incorporate programming into their teaching practices in countries where programming is mandatory in the curriculum. Therefore, future research should focus on designing, developing and evaluating training programmes that improve teachers' attitudes towards programming and strengthen their knowledge to ensure a more equitable and effective implementation of VBP in primary education.

REFERENCES

Acosta, P. M. C. (2021). Pensamiento computacional: habilidades asociadas y recursos didácticos. *Innovaciones Educativas, 23* (Especial), 178-189. https://doi.org/10.22458/ie.v23iespecial.3693

Bandura, A. (1987). *Pensamiento y Acción*. Ediciones Martínez Roca. Bocconi, S., Chioccariello, A., Kampylis, P., Dagiené, V., Wastiau, P., Engelhardt, K., Earp, J., Horvath, M., Jasuté, E., Malagoli, C., Masiulionyté-Dangiené, V., & Stupuriené, G. (2022). *Reviewing Computational Thinking in Compulsory Education.* Publications Office of the European Union. https://doi.org/10.2760/126955

Boletín Oficial del Estado [BOE]. (2018). Ley Orgánica 3/2018, de 5 de diciembre, de Protección de Datos Personales y garantía de los derechos digitales. Boletín Oficial del Estado, 294, de 7 de diciembre de 2018. BOE-A2018-16673. Recuperado de https://www.boe.es/eli/es/lo/2018/12/05/3/con

Boletín Oficial del Estado [BOE]. (2020). Ley Orgánica 3/2020, de 29 de diciembre, por la que se modifica la Ley Orgánica 2/2006, de 3 de mayo, de Educación. Boletín Oficial del Estado, 340, de 30 de diciembre de 2020, 122868-122953. Recuperado de https://bit.ly/46iano7

Declaración Helsinki. (2017). *Declaración de Helsinki de la AMM. Principios éticos para las investigaciones médicas en seres humanos*. Asociación Médica Mundial.

Espino Espino, E. E., & González González, C. S. (2015). Estudio sobre diferencias de género en las competencias y las estrategias educativas para el desarrollo del pensamiento computacional. *Revista de Educación a Distancia (RED), 46*. Recuperado de https://revistas.um.es/red/article/view/240171

Fagerlund, J., Leino, K., Kiuru, N., & Niilo-Rämä, M. (2022). Finnish teachers' and students' programming motivation and their role in teaching and learning computational thinking. *Frontiers in Education*, *7*. https://doi.org/10.3389/feduc.2022.948783

Fang, Z. (1996). A review of research on teacher beliefs and practices. *Educational Research, 38*(1), 47–65. https://doi.org/10.1080/0013188960380104

Finnish National Agency of Education (2016). National core curriculum for basic education. Helsinki: Finnish National Board of Education.

García-Ruiz, R., Buenestado-Fernández, M., & Ramírez-Montoya, M. S. (2023). Evaluación de la Competencia Digital Docente: instrumentos, resultados y propuestas. Revisión sistemática de la literatura. *Educación XX1, 26*(1), 273-301. https://doi.org/10.5944/educxx1.33520

González-Cervera, A., Martín-Carrasquilla, O., & González-Arechavala, Y. (2024). Validación de contenido de una escala sobre actitudes hacia la programación y el pensamiento computacional en docentes de Primaria a partir del método

Delphi. *Pixel-Bit. Revista de Medios y Educación, 70*, 61–79. https://doi.org/10.12795/pixelbit.103692

Hestness, E., Ketelhut, D. J., McGinnis, J. R., & Plane, J. (2018). Professional knowledge building within an elementary teacher professional development experience on computational thinking in science education. *Journal of Technology and Teacher Education, 26*, 411–435. https://www.learntechlib.org/primary/p/181431/

Jaipal-Jamani, K., & Angeli, C. (2017). Effect of robotics on elementary preservice teachers' self-efficacy, science learning, and computational thinking. *Journal of Science Education and Technology, 26*(2), 175–192. https://doi.org/10.1007/s10956-016-9663-z

Jiang, B., & Li., Z. (2021). Effect of Scratch on computational thinking skills of Chinese primary school students. *Journal of Computers in Education, 8*(4), 505–525. https://doi.org/10.1007/s40692-021-00190-z

Jung, U., Lee, J., Choi, J., Yim, H., & Lee, M. (2023). Future service robot scenarios in South Korea. *Sustainability, 15*(22), 15679. https://doi.org/10.3390/su152215679

K–12 Computer Science Framework. (2016). *K-12 computer science framework*. Recuperado de http://www.k12cs.org

Kiliç, S. (2022). Tendencies towards Computational Thinking: A Content Analysis Study. *Participatory Educational Research, 9*(5), 288–304. https://doi.org/10.17275/per.22.115.9.5

Liu, J., Li, Q., Sun, X., Zhu, Z., & Xu, Y. (2021). Factors influencing programming self-efficacy: an empirical study in the context of Mainland China. *Asia Pacific Journal of Education, 43*(3), 835–849. https://doi.org/10.1080/02188791.2021.1985430

Marcelino, M. J., Pessoa, T., Vieira, C., Salvador, T., & Mendes, A. J. (2018). Learning computational thinking and Scratch at a distance. *Computers in Human Behaviour, 80,* 470–477. https://doi.org/10.1016/j.chb.2017.09.025

Mason, S. L., & Rich, P. J. (2019). Preparing elementary school teachers to teach computing, coding, and computational thinking. *Contemporary Issues in Technology and Teacher Education, 19(*4), 790–824. https://www.learntechlib.org/primary/p/184723/

Ministerio de Educación, Formación Profesional y Deportes [MEFD]. *Igualdad en cifras. MEFD 2024*. Secretaria General Técnica. https://bit.ly/4iEQ4Y7

Negrini, L. (2020). Teachers' attitudes towards educational robotics in compulsory school. *Italian Journal of Educational Technology, 28*(1), 77–90. https://doi.org/10.17471/2499-4324/1136

Ortuño, G., & Serrano, J. L. (2024). Implementación y formación del profesorado de educación primaria en pensamiento computacional: una revisión sistemática. *RIED-Revista Iberoamericana de Educación a Distancia, 27*(1), 255-287. https://doi.org/10.5944/ried.27.1.37572

Papert, S. (1980). *Mindstorms. Children, computers and powerful ideas.* Basic books.

Pérez-Calderón, E., Prieto-Ballester, J., & Miguel-Barrado, V. (2021). Analysis of Digital Competence for Spanish Teachers at Pre-University Educational Key Stages during COVID-19. *International Journal of Environmental Research and Public Health, 18*(15), 8093. https://doi.org/10.3390/ijerph18158093

Piedade, J. M. N. (2021). Pre-service and in-service teachers' interest, knowledge, and self-confidence in using educational robotics in learning activities. *EDUCAÇÃO & FORMAÇÃO, 6*(1), e3345. https://doi.org/10.25053/redufor.v6i1.3345

Rich, P. J., Browning, S. F., Perkins, M., Shoop, T., Yoshikawa, E., & Belikov, O. M. (2019). Coding in K-8: International trends in teaching elementary/primary computing. *TechTrends, 63*(3), 311–329. https://doi.org/10.1007/s11528-018-0295-4

Rich, P. J., Larsen, R. A., & Mason, S. L. (2020). Measuring Teacher Beliefs about Coding and Computational Thinking. *Journal of Research on Technology in Education, 53*(3), 296-316. https://doi.org/10.1080/15391523.2020.1771232

Román-González, M., Pérez-González, J., & Jiménez-Fernández, C. (2017). Which cognitive abilities underlie computational thinking? Criterion validity of the Computational Thinking Test. *Computers in Human Behaviour, 72*, 678. https://doi.org/10.1016/j.chb.2016.08.047

Sun, L., & Liu, J. (2024). A gender differential analysis of educational robots' effects on primary teachers' computational thinking: Mediating effect of programming attitudes. *Education and Information Technologies, 29*, 19753-19782. https://doi.org/10.1007/s10639-024-12655-6

Sun, L., & Zhou, D. (2023). K-12 teachers' programming attitudes among different disciplines: Analysis of influential factors. *Journal of Computer Assisted Learning, 40*(2), 375-930. https://doi.org/10.1111/jcal.12895

Torres-Torres, Y.-D., Román-González, M., & Perez-González, J.-C. (2024). Didactic strategies for the education of computational thinking from a gender perspective: A systematic review. *European Journal of Education*, 59(e12640). https://doi.org/10.1111/ejed.12640

UNESCO. (2019). *Educación de niñas y mujeres en STEM: Un estudio sobre el impacto de género en el acceso y la participación en la educación STEM*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000366649

Vasconcelos, L., Ari, F., Arslan-Ari, I., & Lamb, L. (2022). Female preservice teachers stereotype computer scientists as intelligent and overworked. White individuals wearing glasses. *Computers & Education, 187*, 104563. https://doi.org/10.1016/j.compedu.2022.104563

Villalustre, L., & Cueli, M. (2023). Assessing the Computational Thinking of Pre-Service Teachers: A Gender and Robotics Programming Experience Analysis. *Education Sciences, 13*, 1032. https://doi.org/10.3390/educsci13101032

Wijnen, F., Walma Van Der Molen, J., & Voogt, J. (2024). Measuring primary school teachers' attitudes towards new technology use: development and validation of the TANT questionnaire. *SN Social Sciences, 4*(32). https://doi.org/10.1007/s43545-024-00836-6

Wing, J. M. (2006). Computational Thinking. *Communications of the ACM, 49*(3), 33-35. https://doi.org/10.1145/1118178.1118215

Young, D. M., Rudman, L. A., Buettner, H. M., & McLean, M. C. (2013). The Influence of Female Role Models on Women's Implicit Science Cognitions. *Psychology of Women Quarterly, 37*(3), 283-292. https://doi.org/10.1177/0361684313482109

ANNEX

Annex 1

Items Attitudes toward Visual Block Programming Scale

Dimension	Item
Relevance	1. I believe that Visual Block Programming contributes to the development of Computational Thinking and critical thinking in Primary School students. 2. I believe that teaching Visual Block Programming at an early age helps to develop a more positive attitude towards technology in the future. 3. I believe that Visual Block Programming can be useful to reinforce and help students to learn content from other areas/ subjects. 4. I believe that Visual Block Programming should be taught in Primary School. 5. I believe that teaching Visual Block Programming in Primary Education has a positive influence on students' cognitive and emotional development. 6. I believe that using Visual Block Programming in the teaching of the contents of the different areas/ subjects will increase students' motivation.
Self-efficacy	7. I am able to solve Primary School students' programming questions about the basics of Visual Block Programming (sequences, loops, conditionals, operators, variables…). 8. I am able to master programming contents related to Primary Education curriculum on the basics of Visual Block Programming (sequences, loops, conditionals, operators, variables…). 9. I am able to effectively teach the fundamentals of Visual Block Programming (sequences, loops, conditionals, operators, variables…) in Primary Education subjects. 10. I am able to autonomously learn Visual Block Programming (sequences, loops, conditionals, operators, variables…) related to the Primary Education curriculum. 11. I am able to correct errors in the basics of Visual Block Programming (sequences, loops, conditionals, operators, variables…).
Interest	12. I am interested in developments of Visual Block Programming. 13. I am interested in attending Visual Block Programming courses to teach it in the areas/ subjects that I teach. 14. I am interested in incorporating Visual Block Programming into the areas/ subjects I teach in Primary Education.