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ORIGINAL

Empowering Critical Thinking: The Role of Digital Tools in Citizen Participation

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ABSTRACT

The widespread use of digital technologies and the expansion of social networks has created new communication and meeting spaces where people and social and political actors connect with each other. This opens diverse spaces and possibilities for digital engagement in a more accessible, immediate, continuous, egalitarian, and personalized way. Digital technology facilitates learning, dissemination, and access to information, turning it into a means of communication and fueling the practice of critical thinking. In particular civic critical thinking practices improve the organization and effectiveness of civic networks and spaces for citizen participation, ultimately helping to produce responsible, conscious citizens. This study proposes a series of hypotheses based on the relationships between digital learning, critical thinking and civic participation, and tests them using the technique of structural equation modeling (SEM) with partial least squares (PLS) applied to a sample of 191 primary and secondary school students. The results indicate that digital tools have a positive impact on the development of critical thinking, and this influences citizen participation, transforming people into more engaged citizens of the world with participatory attitudes and values.

Keywords CRITICAL THINKING, CITIZEN PARTICIPATION, DIGITAL TOOLS, EDUCATION, STATISTICAL SURVEY.

1 INTRODUCTION

Digital technologies are tools that allow autonomous and easy access to the public sphere, facilitating learning, distribution, and access to information without needing to rely on the intermediation of professional information organizations. These technologies also allow direct interactive communication, which makes them an instrument of interpellation that can help revitalize deliberative practices and critical thinking.

The term ”critical media awareness” refers to the ability of consumers to analyze, question and judge what is presented to them through the media (Del-Moral & Villalustre, 2013 ,

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p.174). In this study, critical thinking is assumed to be a prerequisite for people developing their own way of thinking and taking positions in social situations, playing an active role in cultural and scientific decisions (Solbes & Torres, 2012).

The objective of this research is to identify if digital tools in teaching and learning have a positive impact on the development of critical thinking, and by extension on citizen participation. Thus, through critical thinking and reflection, the aim is to achieve a renewal of the teaching-learning systems where students can develop a determined will for comprehension and action (Yus, 1998). This research posits that teaching and assessing critical thinking and citizen participation can be effectively addressed through learning activities that involve the activation of specific digital skills related to these competencies.

To achieve this objective, this rest of the article is structured as follows: in section 2, the theoretical foundations are presented, followed by the methodology and results in sections 3 and 4, respectively. In section 5, the results are discussed with reference to other recent studies. Finally, section 6 describes the limitations, possible future lines of research and main conclusions of the research.

2 THEORETICAL FRAMEWORK

2.1 The influence of learning based on digital tools on critical thinking

Teaching and learning are transformed by critical thinking, an essential element based on the quality of thinking (Tamayo, Zona, & Loaiza, 2014). Critical thinking is considered a transformative process that integrates cognitive skills, such as analysis, evaluation, inference, explanation, and self-regulation (Cantero, Balboza, & Feria, 2020; Da Costa, Bertacchini, & Alves, 2016; Picón & Correa, 2021). In education, its transformative potential (Picón & Correa, 2021) lies in its ability to restructure learning conditions and foster the exercise of thinking, including multiperspectivism, interpretation, systemic and reflective thinking. According to the theory of critical thinking (Lipman, 1997, 1998), there are several skills and processes that are essential for effective critical thinking. These skills include the ability to analyze and evaluate arguments and evidence, the ability to identify and evaluate assumptions and biases, and the ability to synthesize and apply information effectively (Siegel, 2010).

Currently, educational technology enables effective and critical learning in the digital era, which presents innumerable catalytic advantages, such as flexibility, ease of comprehension, motivation, and sustained attention (Picón & Correa, 2021). In addition, educational technology provides access to various creative digital learning tools and resources (Giuliano, 2008) that encourage participation in specific collective socio-pedagogical contexts, such as cooperative learning. These resources facilitate the resolution of everyday problems, creative and active pedagogical learning actions, and interaction with the environment and with oneself (Becerra, 2015). According to the critical learning theory developed by Freire in 1970 , the objective of education is not only to teach skills and technical knowledge, but also to ensure students develop a critical awareness of inequalities and social and political problems. In this sense, laws governing the educational system have highlighted the need to address certain cross-cutting themes and content related to problematic societal issues and development models, taking a guiding, critical and dynamic approach to opening school to real life (González Lucini, 1994). Students are encouraged to explore and analyze social and political systems, and to reflect on their role in society (Freire, 2020).

The efficiency of information transfer can be improved by using learning methods based on multimedia tools (Mcknight et al., 2016). The use of technology has improved collaboration between teachers and students, freeing them from time and space constraints, as up-to-date learning opportunities are easily accessible. Collective learning is an excellent way to enhance students' critical thinking and encourage their participation in discussions, as well as helping them to take on responsibility and develop as analytical thinkers (Geng, 2021) .

According to Kong (2014), the incorporation of interactive classrooms in pedagogy helps to improve students' knowledge, literacy, and critical thinking skills. The incorporation of ICTs facilitates the creation of a virtual environment for learning, which is an innovative element that enhances the development of the competencies required for citizenship (Sandia Saldivia & Montilva Calderón, 2020). Thus, we formulate the first hypothesis:

H_1: *Learning through digital tools positively influences the development of critical thinking in citizens.*

2.2 The influence of critical thinking on citizen participation

Critical thinking, as a disciplinary process, proposes a rigorous methodology to analyze, synthesize and evaluate information objectively, allowing the thinker to organize his/her knowledge and reach the correct conclusion on a specific topic (Núñez-Lira, Gallardo-Lucas, Aliaga-Pacore, & Diaz-Dumont, 2020). It is a reflective activity that focuses on problem solving in interaction with other individuals, with an emphasis on understanding the nature of the problems rather than on proposing immediate solutions (López Aymes, 2012). Critical thinking plays a fundamental role in citizen participation, as it involves analyzing, evaluating, and reflecting on the information we receive and the decisions we make. By developing critical thinking, people can make more informed decisions, which in turn can increase their level of participation and engagement in public and political affairs.

Citizen participation is essential to ensure social transformation from an intercultural perspective that recognizes the diversity of all those involved, based on their inherent characteristics and social position (Aguado, Melero Hector, & Gil-Jaurena, 2018). In relation to education, the teaching of citizen participation is crucial for the development of the social, cultural, economic, and political aspects of a country, resulting in a freer and more supportive society, where students can find hope and learn to live in happiness and harmony with themselves and with others. However, in practice, citizens shows little interest in participation due to various economic, cultural, geographical, and political factors (Siliézar, 2017), including the political culture and a lack of civic education, trust in institutions, access to information and transparency, and opportunities for participation. Therefore, it is necessary for educational policies to encourage citizen participation in order to ensure the type of quality education that benefits society. In addition, critical thinking can help people evaluate the information they receive from the media, politicians, and other leaders, enabling them to form more accurate and objective opinions and to make better judgments about public affairs. Ultimately, critical thinking can help people act and actively participate in solving problems and making important decisions that affect society at large.

Therefore, we posit the second hypothesis:

H_2: Citizens' critical thinking positively affects citizen participation.

2.3 The use of digital tools in learning and citizen participation

Education today must be constructionist, participatory and popular, with the aim of meeting the needs of society and promoting critical, reflective, and participatory thinking skills in students. In this context, the role of the teacher is that of facilitator, responsible for encouraging the participation and integration of students in the social reality of the school and the community in which they live. Therefore, there is a need to achieve fully cooperative and participatory classrooms, where students feel involved in the learning process and where the teacher is not a mere professional—technically trained in classroom management and teaching skills—but an intellectual and critical creator of curricula (Yus, 1998).

In today's ”Digital Age” or ”Information Society”, social networks and ICTs create new spaces for communication and interaction, which contributes to fostering criticality in individuals (Mossberger, Tolberg, & Mcneal, 2008). ICTs allow users to become actors and protagonists of information, transforming it into knowledge, and to acquire the skills needed to solve complex problems in the sociocultural, political, and economic context (Escofet, 2020). The ICT-based educational approach provides opportunities for the proper development of skills related to communication and interpersonal relationships, such as collaboration, teamwork and problem solving (Arantes de Amaral & Lino dos Santos, 2018). All this is essential for citizenship and allows a more accessible, instantaneous, continuous, egalitarian, and personalized digital participation (Buckingham, 2005).

Freire (1970) critical learning theory places great emphasis on the social relevance of learning. The issues and problems addressed in the classroom should be connected to students' daily concerns and realities. In this way, students are expected to develop a critical awareness of social and political inequalities and problems. Participatory learning is a particularly appropriate strategy for forming a participatory and informed citizenry (Wade, 2000). According to Lucas and Martínez (2012), this allows students to participate in solving complex real-world problems that affect society, which increases motivation and promotes social, emotional, and professional learning. Linking learning requirements with communities and developing civic engagement skills and attitudes are fundamental for educating a responsible, active citizenry capable of solving complex problems (Sandia Saldivia & Montilva Calderón, 2020).

In summary, digital learning can have a positive impact on students' civic engagement by providing them with access to information, developing technological skills, and offering opportunities to engage in online civic activities and political education programs. However, it is important to note that there may also be barriers and challenges related to technology access and digital inequality that must be addressed to ensure equitable civic participation for all students.

H_3: The use of digital tools in learning directly and positively affects citizen participation.

2.4 The indirect effect of the use of digital tools in learning on citizen participation through critical thinking.

As mentioned above, digital learning can provide students with access to a wealth of information from a variety of sources and allow them to approach significant issues in the world from within the school. However, not all online information is accurate or reliable, so it is important that students develop skills to evaluate the quality and reliability of the information they find (Jaramillo, Hennig, & Rincón, 2011). In doing so, students can develop their ability to think critically and make informed decisions on political and social issues (Yacoubian, 2015).

In addition, digital learning often involves gathering information from multiple sources and using tools to organize and analyze that information (Avendaño, Hernández, & Prada, 2021). This can help students develop analysis and synthesis skills, allowing them to identify patterns, make connections, and draw conclusions from complex data that may involve many variables and where the consequences of the decisions being made may be remote in space and time, making them difficult to perceive and understand. These skills can therefore be valuable for citizen participation, as they enable students to identify and understand social and political problems, and to generate creative and innovative solutions (Dekker, 2020). By participating in these discussions and debates on political and social issues they can practice critical thinking and questioning, identifying weak arguments or inconsistencies in the reasoning of others, and offering constructive and well-founded alternatives.

We pose our fourth and final hypothesis:

H_4: The use of digital tools in learning indirectly and positively affects citizen participation, through citizen's critical thinking.

The proposed hypothesis model is shown in Figure 1.

3 METHODOLOGY

The study employed the structural equation modeling (SEM) technique (Nasution, Fahmi, & Prayogi, 2020) with partial least squares (PLS). PLS is especially useful when working with many observable and latent variables, as it can better handle multicollinearity and collinearity. In addition, it offers better model fit and greater robustness to measurement errors (Henseler et al., 2014a). The software used to perform the analyses was SmartPLS 4.0 (Ringle, Wende, & Becker, 2022). In general, SEM analysis follows a two-stage approach: (1) measurement model analysis; and (2) structural model analysis. A questionnaire was designed to test the hypotheses of the model presented in Figure 1. It was distributed online, as this is a quick, effective way to collect opinions on the topic in question. However, it is important to keep in mind that the use of an online survey may exclude individuals who do not have access to the internet.

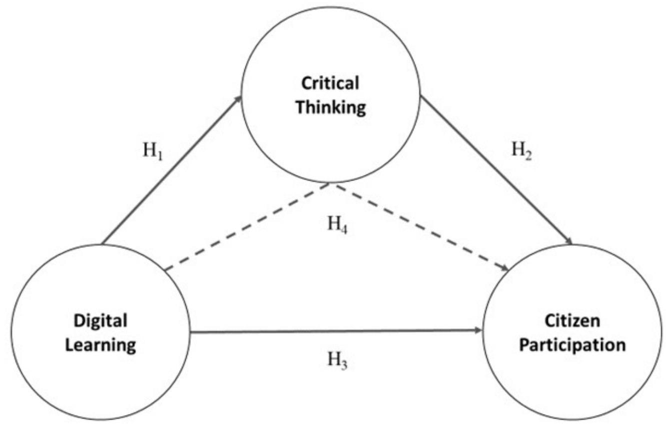

Figure 1 Proposedmodel

3.1 Data Collection and Sample Design

In the present study, the survey responses of 191 Spanish primary and secondary school students between 9 and 16 years of age were analyzed. The data was collected through the Google Forms platform, the link to which was distributed by email to different classes in several schools in Spain. The survey was available between January and March 2020, prior to the Covid-19 lockdowns, and a snowball sampling technique was used to encourage respondents to spread the message among their contacts.

Prior to participation, potential respondents were informed of the objectives of the study and were assured of the anonymity and confidentiality of their responses, as well as their right to participate on a voluntary basis. The final sample consisted of 191 young people, whose sociodemographic profile is described inTable 1 .

Table 1 Sociodemographic profile and attributes of theparticipants.

Variable	Category	Nº	Frequency %
Gender	Male	99	51.83%
	Female	91	47.64%
	N.D.	1	0.53%
Age	Between 9 and 13 years old	72	37.69%
	Between 14 and 16 years old	119	62.30%
	N.D	4	2.09%

Source. Prepared by the authors

3.2 Measuring instruments and scales

The survey was divided into four blocks: sociodemographic characteristics, use of digital tools, critical thinking, and citizen participation. The last three blocks correspond to the latent variables studied (see Table 2), which were evaluated using subjective Likert-type scales to measure the study variables, with measurement values ranging from 1 (strongly disagree) to 7 (strongly agree).

As mentioned above, the first block addressed the sociodemographic characteristics of the participants, such as their gender and age. The second block evaluated the use of digital tools for learning, applying the scale of primary education teachers' perception of student learning based on digital competencies proposed by Meroño, Calderón, Arias-Estero, and Méndez-Giménez (2018).

In the third block, participants' critical thinking was measured using the items from the Critical Thinking Motivation Scales questionnaire (Valenzuela, Nieto, & Saiz, 2011), an instrument that measures the motivation to think critically in relation to five factors: expectations, scope, usefulness, cost, and interest. In this study, only the indicators related to scope were used.

Finally, the fourth block focused on the encouragement of citizen participation, using as a basis the theoretical review conducted by Sales, Moliner, Amiama, and Lozano (2018) on the key factors for citizen participation (Aguado, Ballesteros, & Malik, 2003; Booth, Simón Rueda, Sandoval Mena, Echeíta, & Muñoz Martínez, 2015). Content and construct validity were checked by means of expert judgment and principal component factor analysis with oblique rotation.

4 RESULTS

4.1 Common method bias and multicollinearity test

Following Kock and Lynn (2012) procedure, a full collinearity test was performed to determine whether the results were affected by common method bias, which would negatively affect their validity. None of the variance inflation factors (VIFs) generated for the latent variables in the model exceed the threshold of 3.3, a value proposed as an indicator of the existence of multicollinearity and common method bias (Kock, 2015). Therefore, it can be concluded that the empirical analysis is free of these possible biases.

4.2 Measurement model

The theoretical model proposed in this study was estimated using the PLS-SEM method, with SmartPLS 4.0 software (Ringle et al., 2022) employed to analyze the relationships proposed in the hypotheses. The PLS modeling approach was chosen from among the different SEM methods, as it is not only able to estimate models with latent variables, but also allows for multigroup analysis (MGA) (Rasoolimanesh, Ringle, Jaafar, & Ramayah, 2017; Sarstedt, Hair, Ringle, Thiele, & Gudergan, 2016).

To validate the measurement model, the reliability of the individual indicators was assessed through their loadings (Table 2), as well as internal consistency and convergent and discriminant validity (Table 3). In this work, the results obtained for the outer loadings indicate that the assessment of the reflective measurement model requires an evaluation of the reliability and validity of each variable. Convergent validity was assessed through item loadings, the composite reliability (CR) of each item and the average variance extracted (AVE) for each construct. The loadings of all items on their corresponding variables are above 0.70, as suggested by Carmines and Zeller (1979), and are shown in Table 3. It is worth mentioning that some indicators were eliminated (AD.4 PCR.4) as they did not exceed the recommended minimum value of 0.5 (Bagozzi, Yi, & Nassen, 1998), although the total value remained at 21.1.

Table 2 Measurement model and indicator loadings

Constructs	Items (indicators)	Loadings	Mean	SD	Adapted from
Digital Learning (DL)	DL.1	0.761	2.76	1.40	Meroño García, Calderón Luquin, Arias Estero, & Méndez Giménez, (2018).
	DL.2	0.827	2.92	1.24	
	DL.3	0.797	3.59	1.19	
	DL.5	0.762	3.28	1.18	
Critical Thinking (CT)	CT.1	0.808	3.50	1.09	Valenzuela, Nieto, & Saiz, (2011).
	CT.2	0.789	3.75	1.06	
	CT.3	0.800	3.55	0.95	
Citizen Participation (CP)	CP.1	0.760	3.75	1.00	Sales, Moliner, Amiama, & Lozano, (2018)
	CP.2	0.790	3.73	1.07	
	CP.3	0.711	3.20	1.35	
	CP.4	0.783	3.34	1.27	
	CP.5	0.769	3.62	1.28	

Source. Prepared by the authors

When analyzing reflective measures in PLS, it is important to examine reliability through internal consistency, convergent and discriminant validity (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014). Table 3 presents the reliability and validity measures assessed for each of the three constructs of the proposed model, including Cronbach's α value, the rho correlation coefficient, composite reliability, and average variance extracted (AVE). The value of Cronbach's α, which ranges from 0 to 1, indicates the internal consistency of the components; in confirmatory studies or in advanced stages of research, it is generally accepted that this value should be higher than 0.7 (Gefen & Straub, 2005). In this study, all the constructs studied meet this requirement.

Table 3 Internal consistency and convergent validity ofthe measurement model

Constructs	Cronbach's α	Rho A	Composite Reliability	AVE
Digital Learning (DL)	0.797	0.803	0.867	0.620
Citizen Participation (CP)	0.821	0.823	0.875	0.583
Critical Thinking (CT)	0.717	0.718	0.841	0.639

Source. Prepared by the authors

Regarding composite reliability and the rho A correlation coefficient, both measures exceed the 0.7 threshold recommended by Nunnally and Bernstein (1994) as an adequate level for acceptable reliability. In addition, all constructs meet the AVE criterion, exceeding the 0.50 threshold (Hair, Sarstedt, Ringle, & Gudergan, 2017). Discriminant validity was also tested using the Fornell-Larcker method. Table 4 shows that the variance shared between each construct and its own AVE measures is greater than that shared with other constructs; thus, the values indicating the discriminant validity of the constructs are satisfactory (Hair et al., 2014).

Table 4 Correlations and discriminant validity of themeasurement model

Constructs	(DL)	(CP)	(CT)
Digital Learning (DL)	0.787		
Citizen Participation (CP)	0.574	0.763	
Critical Thinking (CT)	0.522	0.638	0.799

Source. Prepared by the authors

In summary, the three constructs of the proposed model are statistically different and can be used to estimate the structural model, since the measurement model meets the criteria of internal consistency, reliability, and convergent and discriminant validity. The results are presented inTable 3 andTable 4 .

4.3 Structural model

After analyzing and validating the measurement model, the next step is to estimate the structural model to examine the standardized path coefficients and test whether the proposed hypotheses are met. To determine the initial significance of the model and the coefficients of the variables in this study, the recommendation of Brown and Chin (2004) was followed and 5,000 subsamples of the same size as the original sample (n = 191) were generated, using a one-tailed Student's t-distribution and 4,999 degrees of freedom (n-1). Table 5 presents the results obtained for each hypothesis according to the corresponding path coefficient βi.

Table 5 Model results

	β	values	Accepted / Rejected
Digital Learning -> Critical Thinking	0.522	0.000***	H1: Accepted
Critical Thinking -> Citizen Participation	0.465	0.000***	H2: Accepted
Digital Learning -> Citizen Participation	0.331	0.000***	H3: Accepted
Digital Learning -> Critical Thinking -> Citizen Participation (indirect effect)	0.243	0.000***	H4: Accepted

Coefficient(β), P (Sig. p-values < 0.05, one-tailed test) *p<0.05 **p<0.01 *** p<0.001. Source. Prepared by the authors

The results of the structural model (Table 5) show the path coefficients associated with the four hypotheses (Figure 1). In the first hypothesis (H_1), which examines the relationship between digital learning and critical thinking, a positive and significant result was found, indicating that greater use of digital tools for learning leads to greater development of critical thinking. In the second hypothesis (H_2), which studies the influence of critical thinking on citizen participation, a positive and significant result was also found.

In reference to the third hypothesis (H_3), which relates digital learning to citizen participation, a positive and significant influence is confirmed in this direct path.

Regarding the fourth hypothesis (H_4), which relates digital learning to citizen participation through critical thinking, the result was a positive and significant influence on this indirect path.

The R^2 values for the endogenous variables in the structural model are presented in Table 6. These indicators exceed the value of 0.1 that Falk and Miller (1992) suggest can be considered substantial and acceptable. In any case, since this is an exploratory rather than a predictive model, the percentage of variance explained does not have major implications in terms of model validity. Furthermore, the standardized root mean square residual (SRMR) has a value of 0.082, indicating the goodness of fit of the model (Ringle, Götz, Wetzels, & Wilson, 2009). (Henseler et al., 2014b) introduced the SRMR as a goodness-of-fit measure for PLS-SEM that can be used to avoid model specification errors.

Table 6 R^2 of endogenous variables

Constructs	R^2	Adjusted R^2
Citizen Participation (CP)	0.487	0.482
Critical Thinking (CT)	0.273	0.262

Source. Prepared by the authors

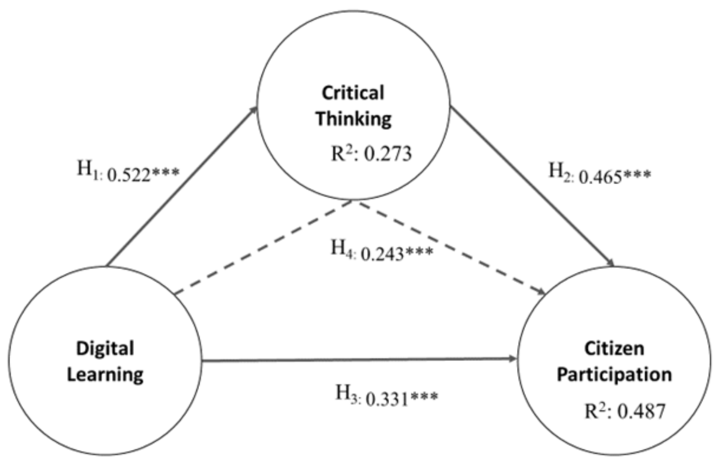

Figure 2 Structuralmodel with results

5 DISCUSSION OF RESULTS

This research develops and tests a new exploratory model of the impact of use of digital tools in learning on citizen participation. The results suggest that the effect of learning on citizen participation is influenced by critical thinking. The findings add to the emerging body of research on citizen participation and learning, and are consistent with previous studies (Escofet, 2020; Sandia Saldivia & Montilva Calderón, 2020). The following findings are worth highlighting:

First, digital learning was found to have a strong impact on critical thinking, which is consistent with previous research in the field (Fajari & Sarwanto, 2020; Fung, 2014; Sari, Sumarmi, Astina, Utomo, & Ridhwan, 2019; Supatmo & Ghufron, 2019; Wahyuningtyas & Wuryadi, 2018) Second, the relationship between critical thinking and citizen participation was verified, in line with other recent studies (Afify, 2019; Albert, Balázs, Butkevičienė, Mayer, & Perelló, 2021; Chen, Zhai, Zhu, & Li, 2022).

Finally, the use of digital tools in learning was found to influence citizen participation both directly and indirectly through critical thinking, which is a relevant finding as few studies have considered these factors in the context of citizen participation (Arnaiz Sánchez, De Haro-Rodríguez, & Maldonado Martínez, 2019; Hussin, Harun, & Shukor, 2018; Ten Dam & Volman, 2004). The analysis of both direct and indirect pathways is important because we see the importance of critical thinking in learning and in citizen participation. Fostering critical thinking in students is therefore vital to transform traditional worldviews, improve their understanding of the world, and empower them to act and participate. The weight of critical thinking does not increase the strength of the relationship, but nor does it diminish its significance. Thus, critical thinking is shown to be a useful tool for enhancing the relationship between digital learning and citizen participation.

These findings contribute to the emerging research in the field of citizen engagement and learning and point to the importance of the use of digital tools for learning and critical thinking in fostering citizen engagement. In addition, the results of this study are consistent with previous research, which supports the credibility of the findings.

6 CONCLUSIONS, LIMITATIONS AND FUTURE LINES OF RESEARCH

Today's society is highly digitized and connected, which has led to a transformation and adaptation of training and education at all levels. Within this context, information, knowledge, and sustainability have become essential for educational progress. This fact is of enormous relevance when it comes to the scope and complexity of collective intelligence, which equips world citizens with specific attitudes, competencies, and skills (Schwab, 2016). Therefore, human beings possess the ability to learn to deal with uncertainty and develop skills such as critical thinking, the desire to innovate and the creation of new knowledge (Sandia Saldivia & Montilva Calderón, 2020). Digital technology becomes an effective means to boost citizen participation in volunteering activities, collective problem solving, community activities and political protest, among others, as evidenced by research (Reig & Disonancia cognitiva y apropiación de las TIC, 2012). Additionally, engaging citizens in the learning process through digital technology not only improves their civic participation, but also enhances the learning process itself, as demonstrated in previous studies (Rutti, Labonte, Helms, Hervani, & Sarkarat, 2016).

The research focused on the impact of digital technologies on education, critical thinking, and civic engagement. The results indicated that digital tools have a positive impact on the development of critical thinking, and that the latter influences citizen participation. In addition, a positive influence of digital learning on citizen participation through critical thinking was found.

However, the study was based on a specific sample of students, which limits the generalizability of the results. Furthermore, the exploratory methodology of the study and its correlational nature suggest that further studies are needed to confirm the validity and generalizability of the proposed model. Finally, other factors that may influence these relationships, such as access to technology or socioeconomic status, were not explored.

Consequently, it is recommended that learning activities involving specific digital skills be included in the teaching and assessment of critical thinking and citizen participation. Future studies are also suggested to address the limitations of this study; for example, the study could be replicated with larger and more diverse samples, or new longitudinal and experimental studies could be conducted, as well as exploring other factors that may influence the relationship between digital learning, critical thinking, and citizen participation. In addition, other aspects related to digital education and citizen participation could be examined, such as the use of social networks and online platforms for the organization of civic and community activities. In summary, this study highlights the importance of leveraging digital technologies in education to impart the skills students need to think critically, awaken their excitement, and transform the world in which they live.

Despite the limitations of this research, a positive relationship was identified between digital learning, critical thinking, and citizen participation. These findings suggest that digital education can be a valuable tool for helping students to develop the skills needed to think critically, participate actively in society, and thus build attitudes that enable self-improvement. Further studies are needed to confirm and expand on these findings, and the limitations mentioned in this study must be addressed to gain a more complete understanding of the relationship between digital education and civic engagement.

7 CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

8 AUTHOR CONTRIBUTIONS

Conceptualization, M.G.-M. and M.A. R.-D.; methodology, M.G.-M. and A.I.C.-A.; software, M.G.-M.; validation; formal analysis, M.G.-M. and A.C.-C.; investigation, M.A. R.-D. and A.I.C.-A.; resources, A.C.-C.; data curation, M.G.-M. and A.I.C.-A; writing—original draft preparation, M.G.-M and A.C.-C.; writing—review and editing, M.G.-M, M.A. R.-D and A.C.-C.; visualization, M.A. R.-D. and A.I.C.-A supervision, A.I.C.-A; project administration, M.A. R.-D; funding acquisition, M.A. R.-D. All authors have read and agreed to the published version of the manuscript.

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1 APPENDIX

Table 1 Questionnaire

	1	2	3	4	5
Digital Learning	1	2	3	4	5
The project allows me to carry out class activities using the computer or the digital whiteboard. DL1					
The project allows me to use technological resources, such as tablets or digital whiteboards, during the classes to learn more.DL2					
The project allows me to select what is important from the information I have found on the internet for the activities. DL3					
The project allows me to present a summary of the news we worked on in class. DL4					
The project allows me to download information that interests me when we use the internet in class. DL5					
Critical Thinking	1	2	3	4	5
The project has allowed me to reason and understand my city better. CT1					
The project has taught me to identify problems in the city. CT2					
The project has taught me to find solutions to problems in my city. CT3					
It is important to me to solve problems in the city. CT4					
Citizen Participation	1	2	3	4	5
What we do in our school/project helps to improve the neighborhood or town.CP1					
What is taught in this school/project is related to things that happen in the neighborhood or town.CP2					
In this school we work as a team to organize many activities with students from other participating regions and countries.CP3					
This school receives help and support from other schools and institutions (the local council, university). CP4					
I feel proud to be part of this school/project.CP5					