THE DILEMMA OF REPLACING TRADITIONAL CALLIGRAPHIC SKILLS WITH TECHNOLOGY IN THE TEACHING OF WRITING. A STUDY OF THE ATTITUDES OF PRE-SERVICE INFANT AND PRIMARY TEACHERS

EL DILEMA DE SUSTITUIR LA CALIGRAFÍA TRADICIONAL POR LA TECNOLOGÍA PARA ENSEÑAR A ESCRIBIR. UN ESTUDIO DE LAS ACTITUDES DE MAESTROS DE EDUCACIÓN INFANTIL Y PRIMARIA

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ABSTRACT

A dilemma concerning the replacement of calligraphy with technology to teach how to write was posed to 312 pre-service Spanish infant and elementary school teachers (PSTs). A series of arguments of a different nature taken from educational professionals were provided to provide the decision-making stage with a solid ground. 60% of PSTs defended their decision on the basis of opinion rather than scientific sources. Pearson's chi-squared test did not show any significant differences when comparing qualification and age with the decision adopted or the nature of the argument. Differences were found in women exhibiting lesser preference for change. As conclusion, we found that there is no consensus amongst PSTs with regards to change. This reinforces the need for the educational community to make an effort to try to improve decision-making and the argumentation skills in PSTs.

Keywords: Educational dilemmas, nursery and elementary pre-service teachers, decision-making, argumentation, digital competence.

RESUMEN

Se planteó un dilema sobre la sustitución de la caligrafía por las tecnologías para enseñar a escribir a 312 maestros españoles de educación infantil y primaria en formación inicial. Para tomar la decisión se facilitaron varios argumentos de distinta naturaleza y sentido tomados de profesionales de la educación. El 60% de los maestros defendió su decisión en base a opiniones frente a fuentes científicas. La prueba chi-cuadrado no detectó diferencias significativas al comparar titulación y edad con la decisión adoptada o con la naturaleza del argumento, encontrándose diferencias en las mujeres, con menor preferencia al cambio. Como conclusión se encontró que no existe consenso entre los maestros al posicionarse ante el cambio. Esto refuerza la necesidad de que la comunidad educativa se esfuerce por tratar de mejorar la toma de decisiones y las habilidades de argumentación de los maestros.

Palabras clave: Dilemas educativos, maestros de educación infantil y primaria en formación inicial, toma de decisiones, argumentación, competencia digital.

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1. Introduction

Although it is abundantly clear that emerging technologies are providing some benefits in the educational field (Tejada, 2018), they are also a problem common to all educational degrees if we consider the most appropriate use of these technologies in the classroom. This problem, which has been a source of discussion for many years, includes opinions ranging from a minimum use of technologies to learning/teaching based exclusively on them. In this sense, social networks add an additional element to the problem by helping the spread of fake news amongst students (Kucharski, 2016), thereby also affecting the educational environment. In many cases, such news results in a public that is unable to discuss certain topics or reach decisions or opinions in this regard and simply accepts the news at face value. This situation may become more extreme if the information received raises controversial social or ethical aspects about which different opinions exist and in which emotions play a role (Sadler & Zeidler, 2005). Such controversies are often related to science and technology due to a general lack of scientific understanding or a misunderstanding in young people, which could in turn lead to problems related to digital skills and decision-making (Simonneaux & Lipp, 2017).

The use of educational dilemmas or situations in which the student must decide between apparently incompatible options in a reasoned manner was chosen. We think these kinds of dilemmas could be suitable for pre-service teachers (PSTs) to develop the ability to take decisions and argue over a dilemma caused by technology in education. This study poses an educational dilemma concerning the replacement of calligraphy with technology-based teaching with the aim of analysing decision-making and the argumentation used by infant and elementary education PSTs.

1.1. The importance of dilemmas in education

In a teaching context, dilemmas are understood to be "problem spaces created in the minds of teachers as they engage in the practice of teaching" (Talanquer et al., 2007). An analysis of dilemmas allows teachers to understand and reveal teaching-related beliefs in order to reflect on them and prepare strategies leading to educational changes (Tomanek, 1994). However, they can also lead to dissatisfaction in teaching professionals as a result of decisions taken in the classroom, therefore it is interesting to reflect on and evaluate the numerous and complex components of teaching practice (Talanquer et al., 2007).

The traditional ways of treating dilemmas imply relating specific situations in which people react to contradictory values, obligations or commitments in which there is often no correct way of acting (Fransson & Grannäs, 2010), with importance being placed on decision-making that affects learning (McAlpine & Weston, 2000).

In this regard, Cuban (2001) distinguishes between problem and dilemma, considering problems to be linear in nature, responsive to careful treatment and which can yield positive outcomes, whereas dilemmas can be parabolic, ineffective strategies are often employed and fail to yield positive outcomes. In this author's opinion, educational change is viewed as a solution to a problem or a compromise to a dilemma. According to Schneider (2018), no progress is possible on dilemmas, and this author gives the implementation of educational policies that have already been tested, even many years previously, as an example.

According to Talanquer et al. (2007), student teachers' dilemmas fall into two main groups: (a) dilemmas associated with student performance and success and (b) dilemmas associated with curriculum and instructional decisions. In this work, educational dilemmas are taken to be different, well differentiated and contrasted options to respond to an assumption or question proposed in the educational field. The dilemma proposed herein corresponds to the second group defined by Talanquer et al. (2007).

Dilemmas have proven to be useful for making progress in educational topics in which controversies have arisen over the years. More than 40 years ago, teachers proposed, amongst others, dilemmas concerning the practical application of theory (McPhie, 1978), the extension of curricula over more years (Gallegos, 1981) or the consensus regarding diversity in schools (Lindsey, 1985). There is currently no doubt regarding the decisions adopted in some of these educational dilemmas, although newer versions have also appeared. Some of the current dilemmas of interest in teacher training include the length of, or need to extend, training programmes given the current rates of teacher hiring (Schneider, 2018), the flexibility of approaches for preparing teachers to face up to the security of training a competent teacher (Schneider, 2018), support to allow teachers to provide responsive teaching (Bottiani et al., 2018) or the preparation of teachers to work with immigrant students (Gutentag et al., 2018).

It should also be remembered that educational dilemmas also depend on other factors, such as public funding, the number of students per class (scale), equality of opportunities (equity) and the importance of education for society (Schneider, 2018). As such, these dilemmas reveal a variety of worries that PSTs have regarding their work and, in particular, those regarding the lack of motivation in students and the resulting effects on performance and teaching, which play a key role in their decisions (Talanquer et al., 2007).

Similarly, some dilemmas may reveal internal inconsistencies in the thought processes of teaching staff when considering dilemmas with conflicting values and beliefs (Marland & Osborne, 1990). When reflecting on these dilemmas, PSTs use this tool to reveal both the nature of their thinking and to help them characterise how they perceive problems and the awareness these students have of their training (Talanquer et al., 2007). Parsons and Stephenson (2005) indicate that the concerns of PSTs and in-service teachers regarding dilemmas vary. Thus, PSTs are more concerned about the difficulties in establishing a working relationship with their colleagues, whereas in-service teachers tend to be more concerned about aiming for equality in the student community.

It is clear that educational dilemmas occur constantly during future professional activities. In this regard, the study of Sutton (2004) regarding the dilemmas he had to face during his training as a teacher as a result of changes to the curriculum and use of the required standard evaluation tests is enlightening. Upon comparing his own experience with that of other teachers, he considered that the teaching context and biography were key factors for decision-making. As such, the proposal to use educational dilemmas as a teaching strategy could be presented a good training as regards future decision-making in a professional context.

Finally, the proposal of dilemmas has also been extended to students as a teaching strategy to obtain information regarding their understanding, epistemological beliefs (Kuhn et al., 2000), ethics (Hoffman, 1998; Loving et al., 2003) or their way of reasoning (Kahn, 1999).

1.2. Recurring dilemmas in education

Despite the numerous topics that can be covered in education, a proliferation of certain topics in educational practice has been detected in the past few years. These include dilemmas with a teaching intent and ethical dilemmas with social repercussions.

With regard to the former, Hoffman (1998) notes that the literature includes good ideas that end up becoming poor educational practice (referred to as "good gone bad"), and that is where the dilemma arises. Some examples of this include the writing process and the writings produced by students, as well as scientific reading activities in class as an indication of students' public speaking skills (Hoffman, 1998). Thus, a teaching intent can be selected as being suitable for a specific context but may turn out to be a dilemma if used in other situations.

In turn, dilemmas concerning ethical and social controversies represent a strategy for promoting decision-making often based on a scientific and technological understanding in class (Zeidler et al., 2005). Moreover, these problems require a basic understanding, a set of beliefs and ideologies that must be based on an ethics and morality that prepares students to reach democratic decisions (Loving et al., 2003). Numerous studies have concentrated on the design of activities for working on social problems from a scientific and technological perspective (Evagorou et al., 2012; Lipp & Simonneaux, 2013; Moreno et al., 2016; Cebrián et al., 2021), with decision-making being essential in order for students to be able to exercise a skill that must be acquired in order to improve, scientific understanding, conceptual awareness, scientific inquiry and social attitudes and values in all cases (Siribunnam et al., 2014; Hierrezuelo et al., 2020).

According to Loving et al. (2003), a first step for working on ethical dilemmas involves providing PSTs with suitable examples for promoting decision-making in class. A second important aspect is trainer training as a lack of training leads to debates with poorly prepared PSTs. However, in order to take a dilemma into the classroom, it should be remembered that a lack of understanding can lead students to arrive at an ethically acceptable solution that nevertheless lacks rigour, which, from a teaching viewpoint, may hinder learning (Simonneaux & Lipp, 2017). Similarly, this lack of understanding can lead students to take a poor social decision outside the classroom when faced with controversies in which they participate, thereby possibly leading to social and personal repercussions.

As such, outside the classroom and in their daily lives, students have to face up to problems that occur with a variety of dilemmas, using informal reasoning, with the majority of these being dynamic in the sense that their assumptions vary in light of new scientific, ethical, moral, political perspectives, etc. (Zeidler et al., 2005). The development of an ability to argue and to think critically is very important to train people who are able to understand and participate in the controversies that crop up during their lives.

1.3. Opinions as evidence for reaching a decision in a dilemma

Decision-making is the final step in the educational dilemma and argumentation must be used to arrive at that decision. Thus, argumentation aims to resolve questions and problems in a rational manner and is therefore is plays a key role in the construction of explanations, models and theories (Toulmin, 1958). It is also an important tool in schools for training responsible citizens who can reach positions and decisions in their lives when faced with different situations (Cebrián & Franco-Mariscal, 2021). Argumentation implies establishing a conclusion based on evidence and justifications, which is a particularly appropriate means of promoting argumentation in class (Puig et al., 2012). Student argumentation is considered to be a procedure equivalent to practical skills and abilities and to the cognitive and communicational abilities need to produce, evaluate and apply a person's understanding (Revel et al., 2005). Its importance in education should also be highlighted as it implies proposing and discussing ideas, evaluating alternatives and choosing between different explanations.

The opinions of different professionals with different viewpoints regarding a dilemma can be used as evidence in an argument (Jiménez-Aleixandre, 2010). This evidence is important as regards forming part of an argument, helping to support a statement, and are also one of the key elements in Toulmin's analytical argumentation model (1958). However, the choice and use of appropriate evidence for decision-making requires backing. This means that the ability to evaluate different evidence or opinions, which is the aim of this work, should be recognised as one of the most complex tasks in the selection and use of evidence when reaching a decision (Evagorou et al., 2012).

Thus, an individual's baseline understanding is essential when choosing the most appropriate evidence to justify an argument and reach a decision (Jiménez-Aleixandre, 2010). Depending on

this baseline understanding, which also includes beliefs and political ideologies, the various opinions can result in a heated debate with a strong moral and ethical basis that will affect the conclusions. According to Zeidler (1997), one of the main difficulties that students encounter when arguing is the effect that their beliefs have on the arguments, which turn out to be more convincing than other arguments that go against those beliefs. This may represent a weakness when students have to hold a position and/or evaluate different criticisms and is conditioned by deeply held beliefs.

1.4. The dilemma of teaching writing skills using technology

The use of technology often results in dilemmas in all stages of teaching practice. These dilemmas are particularly relevant in earlier educational stages as reading/writing skills begin to be learned between the ages of 3 and 6, when the brain is in its period of maximum plasticity (Cisternas et al., 2014), thus explaining the need for studies such as that presented herein in infant and elementary PSTs. The gradual introduction of technologies into the classroom has had a clear influence on the reading/writing process. Although it is clear that these tools have enormous teaching potential, various studies have questioned their suitability in all scenarios. For instance, a study carried out with third-grade elementary school students concluded that the use of technological tools as a strategy for enlivening learning environments helps to improve the development of learning skills, encouraging students to use written language as a means of expressing their thoughts and ideas (Suárez et al., 2015).

However, despite the proven advantages that technology provides to the teaching/learning process, we should consider various variables that affect its success, such as the type of tool, its suitability for the ages concerned, the educational context and the content concerned, amongst others. In this regard, the study by Ohlsson et al. (2002) suggests that the incorporation of technology into an educational setting may be a dilemma as it must be demonstrated that the most recent, or at least non-obsolete, technology is used, but also that it must be based on teaching needs. Indeed, a technological innovation does not necessarily need to be linked to a teaching need or to a benefit in terms of developing students' skills (Hoffman, 1998). Another example concerns the barrier that handwriting may present for some students with motor difficulties, which can hold back their academic performance (Pennington, 2016). In this sense, the study by Pennington (2016) may serve as a guide for the use of technologies in training programmes to support students with writing difficulties.

The globalisation and digitalisation of our society and educational settings have also transformed the educational context and previous requirements for the dilemmas faced by teachers. Digital technology for interaction and learning and social networks mean that the space for the dilemma "becomes virtual". This technological and social progress leads to new ethical dilemmas related to changes in values, beliefs and identities, as well as aspects related to integrity, equity and the law. For instance, the internet and social networks can easily transfer social conflict and tension to an educational context, and conflicts within schools can extend into society.

2. Objectives and hypotheses

2.1. Aims of the study

The aim of this study is to analyse the decision-making argued by PSTs studying for an Infant (IETD) or Primary Education Teaching Degrees (PETD) using fake news taken from the Spanish press regarding the use of technology when teaching how to write. Specifically, this study aims to provide answers to the following research questions:

● Research question 1 (RQ1): Are educational science PSTs in favour or against the exclusive use of technology when teaching how to write?

- Research question 2 (RQ2): How does the content of the argument provided, its nature (public opinion or scientific source) or sense (positive, negative, or neutral) affect decision-making in PSTs?

- Research question 3 (RQ3): Are there any statistically significant differences in decision-making amongst PSTs in terms of their degree courses, sex, or age?

2.2. Design of the dilemma

The objective is to use a dilemma as a technique to promote argumentation in education and which allows us to jointly analyse, between teachers and students, the use of technology with no prior criteria, motivated solely by social pressure in favour of the use of such technology in education. An educational dilemma with social repercussions that aims to generate a debate concerning the use of technology was chosen. To that end, a news item (Antena3, 2014) indicating that Finland intended to stop teaching how to write and would change to an educational system in which children would only learn how to write using technology, from a very early age, was proposed. This fake news received widespread coverage in Spanish media, which could lead to an unthinking acceptance rather than one based on an argumentation as to why psychomotor movements of the hand are so important when learning how to write. This news item provoked a wide variety of opinions from different actors related to education and politics, such as teachers involved in training young students, the children themselves, their parents, the infant curriculum in Finland, schools and politicians, amongst others.

The dilemma was posed in the classroom by presenting the news item together with various contrasting opinions based on which a decision had to be taken as to whether this was an innovative idea suitable for education or not. In this context, innovative is understood to refer to a new way to teach writing skills that differs from standard practice. They were provided with seven arguments that briefly explained their idea (table A) and from which they were asked to choose the one which they considered most suitable for education. It was also suggested that they use these opinions to construct their own argument and reach a decision (see the questions in the appendix).

The research team selected the arguments based on the various sources used by PSTs (blogs, articles in English, etc.), as well as the responses provided most frequently by students when arguing in similar studies (Cebrián et al., 2018), therefore the differentiating factors were not random. Arguments for (+) and against (-) the change in teaching how to write were included, along with one of a more neutral nature (Ø), which presented the advantages and drawbacks of both the use of technologies and writing by hand when taking notes (table A). Arguments that were mostly opinion-based and others of a scientific nature were included. Opinion-based arguments provided similar ideas from the viewpoint of two teachers, a student and a person from outside the educational field, who commented on the news item on their blog or on social networks, and which show that factors such as professional empathy, convictions or pre-held ideas can lead to one decision or another. Scientific sources were taken from articles in indexed journals but were presented with different levels to determine the type of evidence required. Some of these sources provided only the title or a citation from the author, as it has been shown that students can be influenced by the header and title of studies without actually reading them (Cebrián et al., 2018). Another scientific evidence included only an abstract. All these decisions were intentional in order to be able to analyse which situations had the strongest influence on PSTs. Thus, all these subjective versus rigorous factors come into play from an academic, scientific and professional perspective as criteria selected by students in terms of information quality. An understanding of which elements are of greatest use as evidence during argumentation gives an idea of the thought processes that can be influenced in our PSTs. Selection of the arguments provided by the teacher is essential in order to be able to carry out an adequate analysis of the results as the most important aspect of this study is how students reach their final decision rather than the decision itself.

3. Methodology

3.2. Participants

The sample in this study comprised 312 PSTs, 85.6% of whom were studying a PETD and 14.4% a IETD, both in the third year at the University of Malaga (Spain) in the academic year 2017-2018; 71.8% of PSTs were female and 28.2% male. They were aged between 19 and 44 years, with 60.6% being aged 21 or less. When choosing the sample, particular emphasis was placed on the fact that the PSTs had received training in teaching technology and reading/writing as part of their degree studies.

3.2. Statistical analysis

The responses from the PSTs were analysed in detail. Firstly, a descriptive analysis of the data set as a whole, and the variables of which it comprises, was carried out. As all variables were categorical variables, the percentages of the whole study represented by the various categories of variables reflecting the responses given by all the PSTs were studied. Six variables, namely decision, degree, sex, age, content of the argument, nature of the argument and sense of the argument, were used. Subsequently, the data for each variable were compared using Pearson's chi-squared test in order to study the possible existence of significant differences as they are non-ordinal qualitative variables. Analysis was performed using the SPSS statistics software 21.0.

Given the broad age range found, it was decided to study the age variable using an intervals scale. The terciles were calculated to determine the cut-off points, two of which were established with age ranges ≤ 20 years; 21 years and ≥ 22 years.

The nature and sense of the argument variables were created to group the seven arguments into two groups in order to study the possible existence of significant differences based on certain characteristics common to these groups. Thus, the nature of the argument variable classified the variables into two categories depending on the stronger or weaker scientific nature of the source, in other words opinion (arguments 1, 2, 4 and 6) and scientific source (arguments 3, 5 and 7). The sense of the argument variable grouped them into three categories based on their position with respect to the new item: positive (2, 4 and 6), negative (1, 3 and 5) and neutral (7) (table A).

4. Resultados

4.1. Results for research questions 1 and 3

The task proposed a choice between two options representing contrasting positions in terms of the dilemma for the news item and in which the subjects were expected to take the decision as to whether the sole use of technologies to teach how to write was appropriate in education or not. Table 1 presents the results obtained for the decision reached on the basis of degree, sex and age.

Table 1.
Frequency and percentages* of PSTs for the variables analysed in the dilemma

Decision	Total		Degree					
			IETD		PETD		χ2 Pearson	
	f	%	f	%	f	%	χ2	p
In favour of the change	152	48.7	20	44.4	132	49.4	.4	NS
Against the change	160	51.3	25	55.6	135	50.6		
Total	312	100	45	100	267	100.0		

	Sex					
	Female		Male		χ2 Pearson	
	f	%	f	%	χ2	P
In favour of the change	93	41.5	59	67.0	16.5	.000
Against the change	131	58.5	29	33.0		
Total	224	100	88	100.0		

	Age							
	≤ 20		21		≥ 22		χ2 Pearson	
	f	%	f	%	f	%	χ2	p
In favour of the change	43	46.7	46	47.4	63	51.2	0.5	NS
Against the change	49	53.3	51	52.6	60	48.8		
Total	92	100	97	100.0	123	100.0		

* The sum of frequencies and percentages has been made by columns.

The results obtained for RQ1 regarding whether PSTs from educational science are in favour or against the proposed change are unclear as 48.7% of these subjects considered the idea to be appropriate for education whereas 51.3% thought the opposite (table 1).

These data do not differ markedly for each degree (RQ3), with a slight trend against the use of technology for the proposed purpose in both IETD (55.6%) and PETD (50.6%). The chi-squared test confirmed the lack of statistically significant differences ($\chi2 = 0.4$; $p = 0.535$; $\alpha = 0.05$) between degrees and decision reached.

The sex-based analysis (RQ3) showed that 67.0% of males considered the idea proposed to be appropriate with this value being much higher than for women (41.5%). Some of the reasons given by when considering the change base their decisions on the advantages of technology:

"We're living in a digital age where technology rules and we rarely come across a daily need to write on paper by hand, either in an academic or professional setting. Moreover, the time needed to write using a keyboard is shorter than when writing by hand, thus improving the efficiency in class." (PST242, IETD).

Women, in turn, give other reasons for considering that the change is inappropriate, such as the importance of writing by hand for psychomotor development in infancy, the addictions created by technology and its availability in the classroom:

"I don't think this decision is correct for education as technology is already causing numerous problems and addiction in the majority of young children. Moreover, writing by hand is beneficial for the development of arm, hand and finger muscles, and also stimulates the brain. Writing by hand also allows information to be retained better and an individual handwriting style to be developed." (PST124, IETD).

This apparent rejection by women of technology replacing writing by hand was confirmed by the chi-squared test, which found statistically significant differences for the sex variable ($\chi 2$ **=** 16.5; p = 0.000; α = 0.05), thus demonstrating that sex is an important factor to be taken into consideration.

The age analysis (RQ3) (table 1) showed very similar values for all three ranges ($\leq$ 20 years, 21 years, $\geq$ 22 years). Thus, for the first two, the percentage of PSTs who were in favour of the change was 47%, compared with 53% who were against. However, this trend was reversed in the $\geq$ 22 years age range, where 51.2% considered the change to be appropriate and 48.8% thinking otherwise. These results were supported by the chi-squared tests, which found no statistically significant differences ($\chi 2$ = 0.5; p = 0.772; α = 0.05), thus suggesting that this factor does not have a marked influence on decision-making. An example of response was:

"It's true that technology is leaving traditional methods behind, but I still believe that a balance must be found between the two. It doesn't think it's a good idea to stop teaching how to write by hand as this activity helps keep the brain active." (PST988, IETD, female, 20 years).

4.1. Results for research question 2

4.1.1. Analysis of the content of the argument

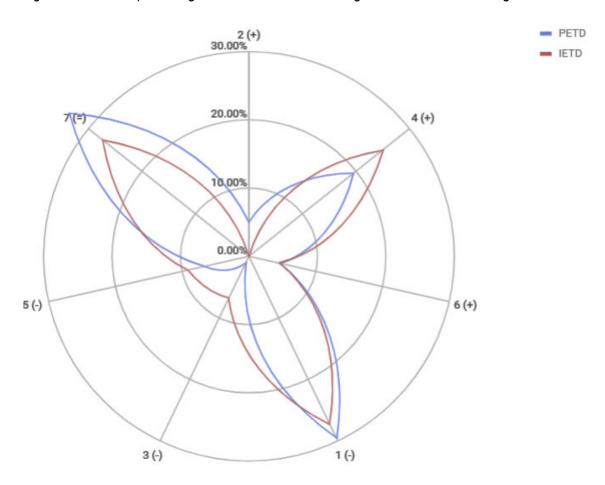Figure 1 shows the percentage of PST who used each argument based on their degree.

Figure 1. Percentages of PSTs studying PETD and IETD who used each argument

The analysis of the content of the argument (RQ2) showed that argument 7, which referred to a comparative study by Aragón et al. (2016) between writing by hand and typewriting, and which provided advantages and disadvantages of using technology and writing by hand, was the preferred option (32.1%) for arguing the decision, as shown by the following example:

"I've decided to use those reflections based on a [scientific] *study rather than merely an opinion as I believe that this is a relevant topic that needs to be treated with the support of a sufficiently strong base to arrive at a correct decision. Source 7 is closest to my way of thinking as I don't believe that either writing by hand or technology need to be eliminated and that both are entirely necessary for a rounded training of students and can be worked on in a complementary manner."* (PST632, PETD, female).

A similar percentage of PSTs (29.8%) opted for the first argument, which was taken from an opinion blog written by an infant school teacher:

"I think the teacher's opinion is correct as it shows that writing by hand has more benefits than we think" (PST181, IETD, male).

Similarly, 22.1% of PSTs chose argument 4, which provided the opinion of a public school teacher:

"I opted for Ramírez's response as his argument highlights that technology helps to achieve speed when carrying out tasks and that children are going to have to use this technology throughout their life, therefore learning to write using a keyboard may prove to be beneficial at this age." (PST831, IETD, female).

Sources 2, 3, 5 and 6, which gave the opinion of a student, a scientific article, the title of a scientific article and a blog post from a non-Spanish writer, respectively, tended not to be used, with percentages of less than 7%.

In summary, there are no marked differences in their choices, as verified by the chi-squared test, which found no significant differences ($\chi2 = 11.7$; $p = 0.069$; $\alpha = 0.05$).

In contrast, significant differences were found when comparing the seven arguments and sex ($\chi2 = 24.4$; $p = 0.000$; $\alpha = 0.05$). The pairwise comparison showed that these differences only arose for source seven, which was of a neutral nature, therefore the study of these differences on the basis of the sense of the argument variable, which we will analyse below, was considered to be more appropriate. Finally, no significant differences were found for the arguments based on age ($\chi2 = 14.5$; $p = 0.272$; $\alpha = 0.05$).

4.1.2. Analysis of the nature of the argument variable

Table 2 shows the data obtained when comparing the nature of the argument with the other variables considered.

The descriptive analysis of the sample as a whole for the nature of the argument variable showed a greater choice of arguments categorised as opinion (59.3%) than scientific sources (40.7%). This appears to suggest that PSTs are influenced more by their own common sense, which means that they choose more subjective arguments rather than others with a more scientific basis. Moreover, the results appear to indicate that, for a single opinion (the digital age is the future, represented by sources 2 and 4), PSTs give more weight to the evaluation of a teacher (22.1%) than to that of a student (3.5%).

With regard to whether the nature of the argument affected the decision taken, no statistically significant differences were detected ($\chi^2 = 1.8$; $p = 0.176$; $\alpha = 0.05$), thus indicating the lack of a correlation between the decision taken and the nature of the argument selected.

Table 2.

Frequency and percentages* of PSTs for each variable analysed based on the nature of the argument

Nature of the argument	Total		Decision				χ2 Pearson	
			In favour of the change		Against the change			
	f	%	f	%	f	%	χ2	p
Scientific source	127	40.7	56	36.8	71	44.4	1.8	NS
Opinion	185	59.3	96	63.2	89	55.6		
Total	312	100.0	152	100.0	160	100.0		

	Degree					
	IETD		PETD		χ2 Pearson	
	f	%	f	%	χ2	p
Scientific source	19	42.2	108	40.4	.1 NS	
Opinion	26	57.8	159	59.6		
Total	45	100.0	267	100.0		

	Sex					
	Female		Male		χ2 Pearson	
	f	%	F	%	χ2	p
Scientific source	92	41.1	35	39.8	.0 NS	
Opinion	132	58.9	53	60.2		
Total	224	100.0	88	100.0		

	Age						χ2 Pearson	
	≤ 20		21		≥ 22			
	f	%	f	%	f	p	χ2	p
Scientific source	36	39.1	41	42.3	50	40.7	.2	NS
Opinion	56	60.9	56	57.7	73	59.3		
Total	92	100.0	97	100.0	123	100.0		

* The sum of frequencies and percentages has been made by columns

In both degrees, around 60% of PSTs opted for sources of opinion. No statistically significant differences were found in the chi-squared test in this regard ($\chi^2 = 0.05$; $p = 0.823$; $\alpha = 0.05$).

When analysing the responses based on sex separately, similar percentages were obtained for women (58.9%) and men (60.2%) in terms of taking opinion-based arguments into consideration, with no statistically significant differences being found ($\chi^2 = 0.04$; $p = 0.834$; $\alpha = 0.05$).

Similarly, the age variable showed that, for the three ranges defined, sources of opinion tended to be taken more into account (around 60%) than scientific sources (around 40%), once again with no statistically significant differences being found in this comparison ($\chi^2 = 0.193$; $p = 0.908$; $\alpha = 0.05$).

4.1.3. Analysis of the sense of the argument variable

Table 3 compares the sense of the argument with the other study variables.

Table 3.

Frequency and percentages* of PSTs for each variable analysed based on the sense of the argument

Sense of the argument	Total		Decision					
			In favour of the change		Against the change		χ2 Pearson	
	f	%	f	%	f	%	χ2	p
Positive	92	29.5	81	53.3	11	6.9		
Neutral	100	32.0	53	34.9	47	29.4	112.3	.000
Negative	120	38.5	18	11.8	102	63.7		
Total	312	100.0	152	100.0	160	100.0		

	Degree					
	IETD		PETD		χ2 Pearson	
	f	%	f	%	χ2	p
Positive	14	31.1	78	29.2		
Neutral	12	26.7	88	33.0	.7 NS	
Negative	19	42.2	101	37.8		
Total	45	100	267	100		

	Sex					
	Female		Male		χ2 Pearson	
	f	%	F	%	χ2	p
Positive	55	24.6	37	42.0		
Neutral	73	32.6	27	30.7	10.6	.005
Negative	96	42.8	24	27.3		
Total	224	100.0	88	100.0		

	Age							
	≤ 20		21		≥ 22		χ2 Pearson	
	f	%	f	%	f	p	χ2	p
Positive	22	23.9	29	29.9	41	33.3		
Neutral	32	34.8	31	32.0	37	30.1	2.3 NS	
Negative	38	41.3	37	38.1	45	36.6		
Total	92	100.0	97	100.0	123	100.0		

* The sum of frequencies and percentages has been made by columns

Most PSTs based their decision on sources supporting a negative (38.5%) or neutral position (32.0%) with respect to the news item (table 3), with those of a positive nature being used less frequently (29.5%). A clear logical relationship between the position chosen and the sense of the argument was observed. Thus, 53.3% (81) of the PSTs who admitted being in favour of the change (152), selected a positive argument, whereas only 11.8% (18) relied on a negative argument. With regard to the decision not to support the change, it can be seen that 63.7% (102) of all PSTs that chose this option (160) opted for a negative argument, whereas only 6.9% (11) opted for a positive one.

An interesting aspect in both cases is the high percentage (34.9% in favour of the change and 29.4% against) who opted for the neutral argument even though the subjects were aware that this is a complex decision in which both positive and negative factors relating to the change must be taken into consideration.

The chi-squared test showed that the sense of the argument is a factor that exhibits statistically significant differences between the study participants when reaching their decision (χ^2= 112.3; p = 0.000; α = 0.05), with these differences concerning the high number of PSTs who opted for the neutral argument.

With regard to the degree (χ^2 = 0.7; p = 0.669; α = 0.05) and age (χ^2 = 2.3; p = 0.687; α = 0.05) variables, no statistically significant differences were found with respect to the sense of the argument (table 3). In contrast, such differences were found with respect to the sex variable (χ^2 = 10.6; p = 0.005; α = 0.05). These latter differences arise from the differences found for the decision variable, which is directly related to the sense of the argument.

5. Discussion and Conclusions

This study aimed to study which decision Spanish PSTs reach when faced with a technology-related educational dilemma that arose in our country as a result of fake news and which types of argument they use to take this decision. The news item concerned suggested replacing calligraphy with technology when teaching how to write. The results show that PSTs are influenced by emotional and fashionable reasoning regarding the use of technology rather than the rational application of technological resources, as also noted by Simonneaux & Lipp (2017). Indeed, there appears to be lack of consensus in both the mass media in this country and amongst educational science PSTs as regards being in favour or against this educational change (RQ1). Thus, some consider fine motor control, which can be practised with calligraphy, to be important, whereas other prefer to opt for the use of technology to develop future skills.

With regard to RQ2, 35% of the explanations were based on arguments that do not provide a clear posture and which are presented in a neutral manner, highlighting both the advantages and disadvantages of using technology or writing by hand. Similarly, around 60% of subjects based their argument on opinions rather than the use of scientific sources. In this regard, this study did not find any statistically significant differences between coming out in favour or against the proposed change and the use of a source of opinion or a scientific source to justify their decision. This reinforces the need for the educational community to make an effort to try to improve decision-making based on argumentative falsehoods in PSTs, as already noted by Zeidler (1997) for argumentation.

The results for RQ3 show that the degree course and age are not related to the decision reached or the choice of a public opinion or one with a scientific basis to justify this decision. This suggests that educational programmes must be adapted to all ages and cycles, and should promote the use of evidence during decision-making (Bravo & Jiménez-Aleixandre, 2018) rather than beliefs (Zeidler, 1997). It also highlights the need for a joint teaching coordination between degree courses, which could benefit students and teachers in terms of developing their ability to reach decisions based on evidence or relevant opinions in social topics. Finally, sex appears to play a differentiating role as regards the preference of using technology or calligraphy, with males tending to be more supportive of the change.

From our perspective, we believe that it is particularly important to implement two lines of work. According to Musgrove et al. (2018), university students tend to be unable to differentiate between real and fake news. As such, initially, we propose to provide pre-service teachers with criteria for evaluating the reliability and credibility of content from various sources of information, particularly the Internet. The activity should present the same news item from different perspectives to allow them to make their own decisions. The vision that these teachers have of reality, and their epistemological beliefs, will affect their ability identify fake news.

The second line is based around the practice of argumentation skills that should take into account the construction of arguments and their critique or evaluation (Osborne et al., 2016). Some interesting activities regarding argumentation include dramatisation classes (Altidor-Brooks et al., 2019), debates (Walton, 2005) or role-playing (Simonneaux, 2001; Hierrezuelo et al., 2021), which can involve the resolution of a problem from various perspectives and with different characters, who must argue their position and argue against the position of others.

All these activities will result in the development of critical thinking abilities in teachers, reinforcing abilities related to (a) reading comprehension, (b) written expression and (c) the ability to listen and verbal expression (Lipman, 1988). In summary, the implications discussed above should enhance these abilities so that teachers are able to analyse and evaluate any problem put to them in an educational setting, generating a global overview of the different viewpoints that may be presented, thus allowing them to take the most appropriate decision.

Funding

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Appendix. Activity of the dilemma

PSTs were required to answer the questions: (a) what decision have you taken?, (b) what opinions, reflections, data, information, etc. did you decide to use to support your decision, and why?, and (c) argue and reflect with the help of the previous two sections. The aim was to collect information concerning the three parts of an argument (conclusions, evidence and justifications). It was decided to maintain PSTs unaware of the false nature of the news item in order to be able to analyse their decision making in the absence of external influences. PSTs carried out the task on-line.

Table A.
Characteristics of the arguments proposed in the dilemma concerning the sole use of technologies to teach how to write.

	Content and sense of the argument	Complete argument	Nature of the argument
1	Calligraphy as a traditional method that promotes psychomotor skills (-)	An infant school teacher on her blog: "We are in favour of writing by hand, as it has always been done this way and also benefits fine motor skills given the need to regulate movements of the hand, fingers, muscles and nerves to produce a desired action" (KTA, 2016)	Opinion of a teacher on her blog
2	The digital age is the future (+)	Student: "Computers and mobile phones are the future, therefore it is normal that paper will be slowly phased out in the not-too-distant future, as this resource promoted development of the student and the student/teacher interaction by way of different applications and platforms"	Opinion of a student
3	Advantages of writing by hand (-)	Paschek, G. (2013). The advantages of writing by hand. *Mente y Cerebro, 62*, 18-21.	Scientific source. Title of the article in an indexed journal
4	The digital age is the future (+)	Francisco Ramírez, public school teacher: "To some degree I consider the introduction of tablets and computers into the classroom to be an excellent initiative give that, as noted in the article, it allows students to work faster and these devices are the future, therefore students should be taught from an early age how to use them and how to type".	Opinion of a teacher
5	Writing by hand stimulates the brain (-)	Azahara (2014): "Neuroimaging studies show that the brain is more active when writing than when typing"	Scientific source. Title of the article in an indexed journal
6	Typing on the computer keyboard stimulates the brain (+)	John Smail: "The neuroscience study carried out in children aged between 4 and 6 years in the USA in 2017 found that writing using a computer keyboard helps them adapt to the adult world and also promotes the speed of writing on the computer, thus creating an electromagnetic signal in the brain that trains it for other competences"	Opinion of an English male
7	Advantages and disadvantages of ICTs and writing by hand when taking notes (Ø)	Aragón et al. (2016). A Comparative Study of Handwriting and Computer Typing in Note-taking by University Students. *Comunicar. 24*(48), 101-107. Abstract: Taking notes is a common strategy among higher education students, and has been found to affect their academic performance. Nowadays, however, the use of computers is	Scientific source. Abstract of an article in an indexed journal

replacing the traditional pencil-and-paper methodology. The present study aims to identify the advantages and disadvantages associated with the use of computer (typing) and pencil-and-paper (handwriting) for taking notes by college students. A total of 251 social and health science students participated in the study. Two experimental conditions were chosen: taking notes by hand (n=211), and taking notes by computer (n=40). Those that used computer-written notes performed better on tasks based on reproducing the alphabet, writing sentences, and recognizing words (p<.05). However, those using handwritten notes performed better on free recall tasks (p<.05). Differences between the two conditions were statistically significant rejecting the hypothesis of equality between groups (X^2=60.98; p<.0001). In addition, the discriminant analysis confirmed that 77.3% of students were correctly classified by the experimental conditions. Although the computer allowed for greater velocity when taking notes, handwriting enhanced students' grades when performing memory tasks.