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Interdisciplinary learning combining engravings and poems by teachers in initial training

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Interdisciplinary is proposed to address a technologic knowledge-based society. This research employs quantitative methodology to analyze the perception of an integrated interdisciplinary practice involving engraving and poetry among 63 teachers in initial training. The goal is to identify correlations between age, gender, and the three dimensions of interdisciplinary. We infer a moderate positive correlation between age and the perception of skills, and a weak correlation with the perception of knowledge and interdisciplinary attitude dimensions, yielding results. This research aligns with the stance in favor of interdisciplinary education, advocating for its importance from pre-university to university levels, as a preparation for students to tackle complexity.

KEYWORDS

attitude, education, engraving, interdisciplinary knowledge, poem, skills

1 Introduction

Interdisciplinarity in education has been reinvigorated by the spread of STEM methodologies (Chiang et al., 2020). Salas Soto (2008) highlighted a wide range of benefits of interdisciplinarity, such as abundance of resources, creativity, collaboration, and professional enrichment. In addition, this author recognizes that it requires an investment of time, energy, and resources, as well as changes in methods, institutions, and self-awareness.

The definition of interdisciplinary (Lattuca et al., 2012) consists of "a perspective, practice or approach to problem solving that draws on knowledge and modes of inquiry from more than one disciplinary perspective" (p. 25). According to St. Clair and Hough (1992), the concept of interdisciplinary teaching is clarified as follows:

> Teachers present content from more than one perspective or discipline; connections between subject areas are made explicit; there is a greater emphasis on application and synthesis of content and skills; instructional and inquiry methods are often student-centered and process-oriented, with a shift in the teacher's role from lecturer to facilitator; collaboration and communication among teachers is emphasized; content studied promotes a full exploration of meaning by demonstrating logical connections rather than isolated and/or fragmented skills; and there is an underlying belief that interdisciplinary instruction motivates both teachers and students (p. 3).

According to specialists and authorities on the subject, such as Dewey (1995), Piaget (1981), Vigotsky (2021), Gardner (2016), Perkins (2017), and Sternberg (2003), it is necessary to develop critical thinking belonging to the learner.

Interdisciplinary thinking, in particular, allows students to benefit in the following three areas because they (1) self-perceive different disciplinary knowledge, (2) become aware of

specific skills for interdisciplinarity, and furthermore (3) are aware of reflective attitudes. This research investigates how university students reflect on these aspects, considering that this is an educational intervention in which contemporary prints by international authors are to be related to contemporary poems also by Spanish authors.

1.1 Self-perception of disciplinary knowledge

According to the literature review conducted, the self-perception of students' disciplinary knowledge through interdisciplinary practice has been a relevant topic in academia since at least 2010 (Pérez Romero et al., 2023). As higher education evolves and focuses on addressing the complex challenges of the knowledge society, interdisciplinarity has become increasingly important. This approach seeks to transcend the usual boundaries of academic disciplines and encourage collaboration between different fields of study.

Interdisciplinary practice (Alvarado et al., 2021) encourages students to develop a deep and broad understanding of the problems and phenomena they face by combining different perspectives and approaches from different disciplines. By participating in interdisciplinary projects, students could apply their disciplinary knowledge in a broader context, understanding how their field of study relates to others and how it can contribute to finding comprehensive solutions (Contreras-Velásquez et al., 2017).

University students, when faced with complex scenarios (Chacón, 2014), require the integration of different disciplines. Interdisciplinary practice challenges students to broaden their horizons and explore new areas of knowledge. As they gain experience in interdisciplinary projects, they may discover the need to acquire additional skills or go deeper (Quintá, 2014) in certain topics to deal more effectively with more complex difficulties.

1.2 Specific skills for interdisciplinarity

For students to succeed in interdisciplinary practices, it is essential that they develop certain specific key skills (Figueroa Céspedes et al., 2020). These enable them to practically address challenges and benefit from the different articulations that arise from the collaboration of different disciplines.

Critical judgment (Sandoval et al., 2013) involves the art of looking at and judging data with equanimity, finding hidden rationales, seeing pros and cons from different angles, and solving wisely. In interdisciplinary endeavors, students must be able to challenge established disciplinary dogmas and look with fresh eyes at a problem as a whole. Similarly, students must know how to articulate their ideas clearly (Almaguer et al., 2016), both to scholars in their own discipline and to those from other disciplines. This includes listening skills (Martínez González et al., 2018), as well as the ability to express difficult concepts with fluency in order to speak to different audiences.

Interdisciplinary work often involves dealing with complicated and uncertain situations with ease and comfort. Students need to be comfortable and adaptable to changes in gaze, modes, and angles (Vargas-D'Uniam et al., 2016). Knowing how to accept and learn from different perspectives, as well as how to deal with doubt and ambiguity, is key to success in interdisciplinary fields. Interdisciplinary thinking (Aguirre Arriaga, 2005) involves understanding how individual parts are connected and how they help the larger system move forward. Students need to be able to find and understand the connections and relationships at work in interdisciplinary contexts (Van der Linde, 2007). This involves understanding complex dynamics and the art of measuring the impact of actions taken by different components of the system.

Effective collaboration (Pozuelos Estrada et al., 2012) is necessary for interdisciplinary assignments. Students must be able to work in groups, appreciate the skills and viewpoints of others, and collaborate fruitfully toward common goals. This requires skills in dealing with others, resolving disputes, and recognizing and using individual strengths for the benefit of the group. Interdisciplinary endeavors require (Rodríguez Fernández, 2022) a never-ending spirit of learning. Students must want to explore new areas of knowledge, acquire new skills, and keep abreast of advances in different fields. This implies an attitude of openness (Torres, 2012) to knowledge, intellectual eagerness, and a desire to seek opportunities for personal and professional improvement.

1.3 Reflective attitudes due to interdisciplinarity

Educational researchers in qualitative methodology develop reflective attitudes when unraveling human phenomena or constructs (Ríos Saavedra, 2018).

Among the most prominent attitudes promoted in interdisciplinary practice are openness to different perspectives, recognition of complexity, questioning of assumptions and biases (Vélez Gutiérrez, 2013), reflection on one's teaching process, appreciation for collaboration and dialogue, intellectual curiosity, intellectual humility, respect and empathy (Nistauz Sorzano, 2022), tolerance of ambiguity (Van der Linde, 2007), taste for innovation and creativity (Jiménez Galán, 2019), as well as a tenacious and resilient character.

From education and psychology related to autonomy and confidence in the ability and skills to solve problems, we find the theory of self-efficacy formulated by Bandura (1999). This author suggests that confidence in one's own abilities affects motivation and task performance. According to this perspective, those who are confident in their ability to solve problems are more likely to face challenges and persist in their search for solutions. Zimmerman's (2002) theory of self-regulated learning should also be considered. This theory focuses on the importance of self-regulation and autonomy in the classroom. According to this theory, individuals who are able to set goals, monitor their progress, and regulate their own learning tend to be more effective at finding solutions to difficulties and achieving their goals.

Flavell is a leading cognitive psychologist known for his work on metacognition and self-reflection. Flavell (1979) examines the importance of both in cognitive development and decision making. He explores how the ability to reflect on one's thoughts and monitor cognitive processing can influence productivity and problem solving.

In this context, it is relevant to investigate the interactions among the mentioned theories, such as Bandura's theory of self-efficacy, Zimmerman's theory of self-regulated learning, and Flavell's concepts of metacognition and self-reflection. These theories converge in their

focus on the importance of personal perception and regulation in the learning process, but they also complement each other by offering distinct and complementary perspectives on how students can develop interdisciplinary skills. Delving deeper into the integration of these theories in the context of interdisciplinary practice could enrich our understanding of how students acquire and apply knowledge in academic and professional environments.

1.4 Interdisciplinary research on the visual image in conjunction with the written literary text as a key resource

The relationship between the visual image and the written literary text has been the subject of interdisciplinary studies in different academic fields. Several previous studies (Vargas-D'Uniam et al., 2016); have explored the relationship between the visual image and the literary text from an interdisciplinary perspective, or even as a resource to connect it with the transdisciplinary (Martínez-Puente, 2021). For example, in the field of educational interventions, Vásquez Cáceres (2021) found a positive correlation in an intervention with elementary school students. In terms of teacher training, (Pérez Romero et al., 2023) recommended that educational agents in the arts environment who are responsible for addressing inclusion receive prior interdisciplinary training.

As Poyatos (1978) pointed out, comparative literature studies the interactions between different literary traditions and the connections between texts written in different languages and cultures. In this context, interdisciplinary analyses have been carried out (Vieites and Caride Gómez, 2017) that consider the relationship between the visual image and the literary text in works from different literary traditions. Interdisciplinary interventions have also been carried out with visual objects in the case of autism (Madariaga and Larraín, 2022). The intersection between literature and the visual arts has been the subject of studies in fields such as art history and literary theory. These studies explore how visual images intertwine with literary texts, whether as illustrations, in collaborations between artists and writers, or as recurring themes in literary works.

Semiotics, the study of signs and systems of meaning, has been applied to the analysis of the relationship between the visual image and the written text. Interdisciplinary semiotic approaches (Salguero-Rosero and Loza, 2022) have examined how connections are made and meanings are created through the interaction between text and icon in literary and artistic contexts. The adaptation of literary works to other transmedia formats, such as film, television, or comics, has led to interdisciplinary research (Odetti et al., 2020; Suárez-Guerrero and Barberá-Gregori, 2021) on the relationship between the visual image and the literary text. These studies explore how the visual and narrative elements of the literary work are translated and transformed in different media. Finally, visual and narrative communication studies (Acevedo-Zapata, 2021) analyze how meanings are constructed and transmitted through images and texts in different contexts.

In the present research, the research questions are established on an intervention that relates prints and contemporary poems. The first one is: have the teachers in initial training enjoyed experiencing an interdisciplinary practice; the second one is: how do they perceive interdisciplinarity?

The hypotheses that are projected in this inquiry consist of:

First Hypothesis

H_0: Gender does NOT affect age.

H_1: Gender influences age.

Second hypothesis

H_0: Median female is equal to median male.

H_2: Median female is NOT equal to median male.

Third hypothesis

H_0: The data of the groups follow a normal distribution.

H_3: The data of the groups do NOT follow a normal distribution.

Fourth hypothesis

H_0: Me1 = Me2 = … = Men There is NOT a statistically significant difference between the medians.

H_4: There is a significant difference in the medians.

Fifth Hypothesis

H_0: The variables are independent (there is no relationship between the variables).

H_5: The variables are NOT independent (there is a relationship between the variables).

Sixth Hypothesis

H_0: The variable age is correlated with other variables.

H_6: The variable age is NOT correlated with other variables.

2 Methods

2.1 Participants

The individuals are part of a group of students in the first year of the Primary Education program at the University of Huelva. There are a total of 63 informants in the academic year 2022–2023. The sample is made up of 40 female members (63.5%) and 23 male members (36.5%).

The average age represented presents certain differences with respect to the gender of the sample, namely, the female gender is

19.92 years, the male category is 20.57 years. The sample mean is 20.22 years with a standard deviation of 4.1.

In addition, in order to further investigate the sample of participants, the following hypotheses are made on the variables of gender and age:

> H_0: Gender does NOT affect age.
>
> H_1: Gender influences age.

This will be tested using the U-Mann Whitney-Wilcoxon test for nonparametric variables. In this nonparametric test, the following hypotheses are made:

> H_0: Median female is equal to median male.
>
> H_2: Median female is NOT equal to median male.

After the U-Mann Whitney-Wilcoxon analysis shown in Table 1, it is found that the p-value = 0.289 is greater than 0.05, therefore the null hypothesis H_0 is not rejected, since there is no statistically significant evidence to think that the medians of age are different according to gender. In short, age does not depend on gender.

2.2 Tools and materials

For the collection of quantitative data, the validated questionnaire of Hernández-Armenta and Domínguez (2019) was used to assess perceptions of interdisciplinarity. The questionnaire consists of 3 dimensions: first, perception of disciplinary knowledge. Second, perception of skills for interdisciplinarity. Third, perception of reflective attitudes.

The form was made available through a Google Forms link in Moodle. It is a questionnaire for undergraduate students in Education. The questions can be found in Supplementary materials.

2.3 Procedure

In a first phase, the intervention of an interdisciplinary practice was applied in the subject of *didactics of plastic and visual creation* in primary education for 3 weeks during the academic year 2022–2023. The intervention was programmed by two teachers, one belonging to the field of artistic didactics and the other to the field of language and literature didactics. In practice, they were introduced to interdisciplinary thinking. It was explained to them that they would carry out a series of tasks with this more complex type of thinking, the interdisciplinary one. In practice, they would create synaesthesis between engravings and contemporary poems. The engravings would be part of an international traveling group exhibition. The contemporary Spanish poems would be selected from the anthology made available on the web by the Instituto Cervantes (see Supplementary materials).

The students had to look at the print first and then read the poem placed just below it. They did this individually and could comment on it with their team. The intervention, the description of the materials and the access to the source of the materials are detailed in Supplementary materials.

In a second phase, the university students, after this experience through the didactic intervention, knew that they could fill in the questionnaire voluntarily. After the interdisciplinary programmed exercise in class, the students could complete the questionnaire in the same week. The data collection was based on quantitative data collected from the sample using Google Forms, which allows the data to be stored in Excel, a format that allows easy data processing.

TABLE 1 Median ages with respect to gender.

Test de U-Mann Whitney-Wilcoxon
Wilcoxon rank sum test with continuity correction
data: Age by gender
$W = 377.5$, p-value = 0.289
Alternative hypothesis: true location shift is not equal to 0

Source: own elaboration.

2.4 Data processing

Quantitative data in Excel were transferred and processed using the statistical program R Commander and IBM SPSS Statistics software version 26.0. Statistical tests were performed at a 95% confidence level. In addition, the data mining program Orange was used to generate graphs. First, descriptive statistical tests such as Shapiro–Wilk or Kolmogorov–Smirnov-Lifford or interquartile range were performed. Inferential statistical tests for non-parametric independent groups of Whitman's U and Kruskal-Wallis were then performed in this program. Both allow us to know whether or not there is a relationship between two categorical or nominal variables. When necessary, a Spearman correlation test (simple linear) was performed to contrast hypotheses and find out what type of relationship is established between variables.

3 Results

3.1 General descriptive data

The normality test of the quantitative variables is also included. This test will be used in future hypothesis tests to determine whether parametric or non-parametric tests should be used.

When the Kolmogorov–Smirnov test is performed, the p-values are very low (less than 0.05), as can be seen in Table 2 of the normality test, and the null hypothesis H_0 is rejected. Therefore, the data of the groups do not fit a normal distribution. Thus, the alternative hypothesis is recognized. This establishes that the data contain a non-parametric behavior.

3.2 Participants' satisfaction with interdisciplinary practice

The sample's perception of interdisciplinary didactic practice was very positive, as reflected in the percentages in Table 3.

3.3 Participants' perceptions of the three dimensions of interdisciplinarity

Similarly, the mean of the three dimensions perceived by the sample shown in Table 4 shows a similar mean in all three dimensions.

3.4 Test of the independence of the variable *You liked it* with respect to the variable *You enjoy thinking* (perception of interdisciplinary skills dimension)

Permission must be obtained for use of copyrighted material from other sources (including the web). Please note that it is compulsory to follow figure instructions. The Kruskal-Wallis test is also used to test whether there are statistically significant differences between two or more groups for an independent variable with respect to an ordinal or continuous dependent variable.

The initial hypothesis of this test is:

> H_0: Me1 = Me2 = … = Men There is NOT a statistically significant difference between the medians.
>
> H_4: There is a significant difference in the medians.

Therefore, it is specifically asked whether there is a relationship between the variable *You liked the practice* (Satisfaction with interdisciplinary practice) and the variable *You enjoy thinking about how different fields of study approach the same problems from different paths*. According to the Kruskal-Wallis test, since the *p*-value = 0.002291 is a value less than =0.05 (significance level), the null hypothesis H_0 is rejected, it can be formulated that statistically there is a significant difference between the medians belonging to the groups that liked the program according to whether these people enjoy thinking. Furthermore, according to the medians, the following values are available: Me *I like it a lot* = 5 > Me *I like it quite a lot* = 4.5 > Me *I like fairly* = 4. So, statistically speaking, the people who like the program the most are the ones who enjoy thinking the most.

TABLE 2 General descriptive data.

			Statistics
Age	Mean		20,2222
	95% confidence interval for the mean	Lower limit	19,1678
		Upper limit	21,2767
	Mean		19,0000
	Deviation		4,18694
	Kolmogorov–Smirnov (*p*-value)		0,000

Source: own elaboration.

3.5 Tests of independence between gender and the three dimensions

First of all, the results show very few differences between the three dimensions of interculturality, as can be seen in Table 5, with the results of the Mann–Whitney U test. From the results, in the tests of independence, when the *p*-value is not significant ($p > 0.05$), it is possible to accept with 95% confidence the hypothesis that there is no statistically significant difference in the mean of the variable between the different genders.

3.6 Relationship of independence of *gender* with respect to the variable *When I struggle*

Table 6 shows the descriptive results of the item in terms of frequency related to *When I struggle*, taking into account the different response options:

Looking at the interquartile range results from the relationship between *the gender* var*iable* and *When I struggle*, the results indicate that since the interquartile ranges do not overlap (2.10 to 3.70 for "female" and 2.56 to 3.96 for "male"), it can be said that there is a difference in people's responses between the two genders. This difference is consistent with the Mann–Whitney U-test discussed below.

Therefore, these two hypotheses are proposed:

> H_0: The variables are independent (there is no relationship between the variables).
>
> H_5: The variables are NOT independent (there is a relationship between the variables).

Indeed, the Mann Whitney U test shows that there is dependence of *When I struggle* (Sig 0.034), corresponding to the dimension *Perception of interdisciplinary knowledge*, with respect to gender. Thus, with a 95% confidence level, the hypothesis that formulates the

TABLE 3 Did you like the interdisciplinary practice of combining engraving and poetry?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Little	1	1.6	1.6	1.6
	Good	29	46.0	46.0	47.6
	Fairly	20	31.7	31.7	79.4
	Very much	13	20.6	20.6	100.0
	Total	63	100.0	100.0	

Source: own elaboration.

TABLE 4 Media mean in three dimensions.

	Mean	Deviation	Mean	Percentile 25	Percentile 75
Perception of disciplinary knowledge	3.61	0.36	3.50	3.50	3.75
Perception of skills for interdisciplinarity	3.80	0.34	3.75	3.63	4.00
Perception of skills for interdisciplinarity	3.52	0.52	3.50	3.00	4.00

Source: own elaboration.

TABLE 5 Mann–Whitney U test.

	Perception of disciplinary knowledge	Interdisciplinary skills awareness	Perception of reflective attitudes
Mann–Whitney U	419.000	412.500	404.000
W Wilcoxon	695.000	688.500	680.000
Z	−0.605	−0.683	−0.808
Asymptotic significance (bilateral)	0.545	0.494	0.419
a. Grouping variable: GENDER			

Source: own elaboration.

existence of a statistically significant difference in the mean value of the variable *When I struggle,* and *gender* can be supported.

3.7 Correlation between the variable *age* and *dimensions*

Regarding the median of the variable *age* and *Did you like the practice*, the age factor was a determining factor in the gradual response of the sample. If the interquartile range is considered for the medians of the responses *quite a lot* and *fairly*, both are close to 19.4 years and have similar IQRs. This indicates that the ages of the people who selected these responses are similar in terms of dispersion. On the other hand, the median of the response a lot is significantly higher (23.15 years) and has a wider IQR, suggesting that there is greater variability in the ages of the people who chose this response.

The next step of the statistical analysis consists of hypothesis testing through Spearman's correlation of linear type, considering only two variables (simple). Specifically, this test measures whether age is correlated with the three dimensions of interdisciplinarity. The concept of relationship or correlation refers to the degree of correlated variation found between two or more variables.

As in this case, there is a positive linear relationship between two variables. The values of both variables oscillate in a similar way. The results of the correlation found in Table 7 between age and two dimensions (perception of knowledge and perception of reflective attitudes) are of a weak positive type. As for the dimension of *interdisciplinary skills*, the correlation is moderately positive.

4 Discussion and conclusion

The interdisciplinary exercise in higher education encourages all disciplines and all areas of the documentary review on this issue. Research that reaches the three dimensions of interdisciplinarity of this study has been discovered, as will be discussed below. Likewise, previous interdisciplinary interventions and related inquiries (Vargas-D'Uniam et al., 2016; Vieites and Caride Gómez, 2017; Martínez-Puente, 2021) have been carried out between artistic objects and literary products in higher education.

Regarding the hypotheses, in this research, the null hypotheses H_1 and H_2 are inferred that age does not depend on gender, in accordance with the statement that the median of women is equal to the median of men. Regarding H_3, the alternative hypothesis is inferred that the data of the groups do not behave with a normal distribution, but with a nonparametric one.

4.1 Dimension: satisfaction with interdisciplinary practice

This study specifically highlights the very positive satisfaction of an interdisciplinary practice on the part of initial teacher educators. This conclusion connects with the recommendations of experts in the context of education regarding the promotion of interdisciplinarity, the fostering of a reflective attitude in the academic environment, and the need to strengthen critical thinking skills. Among these authorities and experts are Dewey (1995), Piaget (1981), Vigotsky (2021), Gardner (2016), Perkins (2017), Sternberg (2003), among others. If anything, these authors transcend the specific scope of the study and raise the importance of developing transversal competencies that allow students to address complex challenges from a broad and holistic perspective.

Moreover, this positive satisfactory appreciation of university students is in line with other previous studies with university students (García Cabanillas et al., 2009; Folgueiras Bertomeu et al., 2013; Suárez et al., 2013; Villamizar et al., 2013; Escario Gracia et al., 2021), as well as with other educational levels, such as Primary Education (Méndez-Giménez et al., 2010; Espejo-García et al., 2022). In this study, the particularity with respect to the age variable has been discovered. In such a way that the median response much, in terms of satisfaction with the practice, is a significantly higher age range (23.15 years) and with greater variability in the ages of the people who chose this response.

Likewise, it is said that the interaction between different disciplines and encouraging the exploration of multiple perspectives (Suárez Monzón et al., 2018) can enrich the penetration and search

TABLE 6 When I struggle with a class activity or assignment, I am unaware that my difficulty is due to the fact that I only know how to think "the way I was taught to think in my career."

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Disagree	15	23.8	23.8	23.8
	Neither agree nor disagree	35	55.6	55.6	79.4
	Agree	9	14.3	14.3	93.7
	Strongly agree	4	6.3	6.3	100.0
	Total	63	100.0	100.0	

Source: own elaboration.

TABLE 7 Correlation between age and dimensions.

Spearman's rho		Age	Perception of disciplinary knowledge	Perception of skills for interdisciplinarity	Perception of reflective attitudes
Age	Correlation coefficient		0.160	0.062	0.204
	Sig. (bilateral)		0.210	0.627	0.108
	N		63	63	63
Perception of disciplinary knowledge	Correlation coefficient			0.296*	0.076
	Sig. (bilateral)			0.018	0.552
	N			63	63
Perception of skills for interdisciplinarity	Correlation coefficient				0.379**
	Sig. (bilateral)				0.002
	N				63

*Correlation is significant at the 0.05 level (bilateral).
**Correlation is significant at the 0.01 level (bilateral).
Source: own elaboration.

for solutions to complex hurdles, as well as foster creativity and innovation (Jiménez Galán, 2019) in line with other studies (Restrepo Acevedo et al., 2020). Therefore, these findings support the importance of promoting a multidisciplinary approach in higher education and highlight the benefits of adopting an open and flexible mindset toward different areas of knowledge.

4.2 Dimension: perception of interdisciplinary knowledge

It can be observed that there is a certain weak positive correlation between age and the perception of interdisciplinary knowledge. In this sense, this ability to perceive interdisciplinary knowledge should be enhanced at pre-university age to ensure preparation for a world of work that poses complex problems and the need to innovate in a competitive market. In fact, previous research has highlighted that the ability to identify and use the foundations and evidence from different disciplines is essential to address complex problems and promote innovation (Del Despósito San Martín, 2023).

4.3 Dimension: perception of skills for interdisciplinarity

In this research, it is statistically found that the people who liked the practice the most are the ones who enjoy thinking the most. H_4, alternative hypothesis, is fulfilled since there is a significant difference between the medians. This finding is consistent with the research of Martínez de Ojeda Pérez et al. (2012). Their study reflects the satisfaction of students in finding practical applications and connections between three disciplines. There is another positive study (Villegas Anacona et al., 2020) on the evolution of the improvement of skills carried out after a longitudinal intervention.

The alternative hypothesis H_5 that the variables are not independent is accepted because there is a dependence of the variable *When I struggle to develop an activity in class or homework, I do not know that my difficulty is because I only know how to think the way I have been taught to think in my career* in relation to gender.

It is a contribution of this research that there is a moderate positive correlation between age and the *interdisciplinary skills dimension*. Therefore, H_6, the null hypothesis that the variable *age* is correlated with other variables, is fulfilled in the 3 dimensions.

4.4 Dimension: perception of reflective attitudes

Campos Daniel et al. (2016), after provoking an interdisciplinary debate, achieved a positive result in terms of attitude change. The study is consistent with the results of Chiang et al. (2020), from an interdisciplinary intervention, in which a change is observed in terms of reflective attitudes depending on cognitive development.

In this research, it is concluded that there is a weak positive correlation between age and the dimension of perception of reflective attitudes.

Finally, it supports previous literature that highlights the importance of interdisciplinary work and collaboration in the search for solutions to complex dilemmas (Lavega Burgués et al., 2013). It is also concluded that, with all these results, the two initial research questions are answered.

4.5 Dimension: perception of reflective attitudes

Critical reflection and reflective attitudes should be promoted at all educational levels, including pre-university and university education. The faculty at other levels should also focus their efforts on enhancing the perception and use of interdisciplinary knowledge from an early age, while university lecturers should continue to foster interdisciplinary practice, collaboration, and critical thinking to improve students' satisfaction and professional preparedness for the new working environment.

4.6 Dimension: curriculum design and pedagogical approach to teaching formation

Firstly, our findings suggest that interdisciplinary practice is positively perceived by educators in training. This satisfaction may serve as an indicator of the effectiveness of pedagogical approaches that integrate multiple disciplines in the classroom. Therefore, teacher training programs could consider the inclusion of meaningful interdisciplinary experiences as an integral part of the curriculum, providing opportunities for future educators to experience and understand the benefits of collaboration across disciplines.

Additionally, educators in training's perception of their interdisciplinary skills and their ability to critically reflect are also key aspects to consider in curriculum design. Teacher training programs could incorporate activities and practices that foster the development of these skills, offering students opportunities to explore different perspectives and address complex problems collaboratively.

It is important to note that our findings suggest a positive correlation between age and the perception of interdisciplinary knowledge, as well as critical reflection ability. This indicates the importance of starting to foster interdisciplinary skills and reflective attitudes from early stages of teacher training. Therefore, teacher training programs could consider implementing pedagogical strategies that promote these skills from the outset of training.

4.7 Limitations and challenges

Certain limitations are considered as these results are based on the responses of informants. There may be other factors involved in the ability to identify distinctive knowledge from other fields. Future research could conduct a qualitative investigation in combination with another quantitative investigation on a longitudinal sample with a broader range of ages. Challenges and strategies for developing interdisciplinary skills could also be further explored, as well as how these outcomes relate to academic or professional performance in specific contexts.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

BP-A: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Supervision, Writing – original draft, Writing – review & editing. SA: Conceptualization, Funding acquisition, Project administration, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2024.1358264/full#supplementary-material

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