Improving motivation in pre-school education through the use of project-based learning and cooperative learning

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Introduction: The emphasis on skills-based learning has caused curricular change in education systems across the European Union, particularly in terms of the increased use of active teaching methodologies at all stages of education. These sorts of methodology are proven to have a positive impact on students' motivation to learn and involve teaching strategies that represent a significant departure from traditional approaches. In this way, teachers in Pre-school Education can employ play-based strategies, which not only foster students' acquisition of new skills but also their motivation. The objective of this study is to assess the impact of using active methodologies on the intrinsic motivation of students in the second cycle of Pre-school Education (3−6years old) toward the process of teaching and learning.

Methods: To this end, a quantitative investigation was undertaken involving a non-probabilistic, convenience sample of 77 students in publicly funded Pre-schools. The selected students were asked to complete an *ad hoc* questionnaire to measure their motivation with respect to the methodology implemented in their classroom. Data were analyzed using the statistical program SPSS v.26 statistical significance was reached for all motivation variables ($p < 0.05$).

Results: A particularly important result was the finding that motivation among our pre-school cohort varied strongly in relation to sex with girls demonstrating greater motivation than boys.

Discussion: Also of interest are the findings that older pupils showed higher levels of motivation and students in the rural center were more motivated than those who study in the urban center. In conclusion, the implementation of active methodologies in Pre-school Education appears to foster students' motivation to learn.

1. Introduction

In recent years, educational systems across the European Union have undergone huge curricular change with the aim of firstly, guaranteeing high-quality education for all and

secondly, offering opportunities for life-long learning (United Nations Educational. Scientific and Cultural Organization, 2016). In Spain, this change has been reflected in the legal framework through the establishment of a new Organic Law whereby the Organic Law for Education is modified (the so-called LOMLOE; Ministry of the President, Constitutional Affairs, and Democratic Memory [MPR], 2020). This law gives particular importance to the use of active methodologies at all educational levels, including that of Pre-school Education due to the way in which such methodologies enable the acquisition of basic skills through play-based learning as set out in the Legal Order, ECI/3960/2007 of 19th December, which defines the curriculum and regulates the organization of Pre-school Education (Ministry of the President, Constitutional Affairs, and Democratic Memory, 2007). This particular piece of legislation was designed to accommodate the recommendations of the European Union (European Commission, 2020) and the International Bureau of Education (Marope et al., 2018), concerning the embedding of skills-based learning to optimize processes of teaching and learning.

The legislative changes outlined above have become of even greater importance in the field of education due to the effects of the COVID-19 pandemic, specifically, highlighting the need to implement innovative methodologies in order to deliver on-line learning successfully (García-Peñalvo et al., 2021). The impact of the pandemic has highlighted the need to use active methodologies to offer students a high-quality education (Souza and Bezerra, 2021) something that is further supported by work such as the study completed by Izagirre-Olaizola and Morandeira-Arca (2020), which concluded that employing active methodologies during the COVID-19 was of significant benefit to students' acquisition of new skills. In the same context, active methodologies have been proven to increase students' learning motivation in the Pre-school Education phase (Jamilah et al., 2021).

2. Theoretical background

The curricular changes affected with respect to skills-based learning are designed to enable students to acquire the learning (knowledge, skills, values, and attitudes) fundamental to their future development as citizens in society (Mutale and Malambo, 2019). The skills that students learn during the pre-school phase of their education form the basis of this process, that is, they are integral to students' personal and social development (Ministry of the President, Constitutional Affairs, and Democratic Memory, 2022). Thus, with skills-based learning at the heart of all phases of education, it must be considered as the ongoing basis for the teaching and learning process (Delors, 1996).

Curricular change has had repercussions at methodological level, lending the role of teachers a particular importance in the ongoing process of adapting educational systems (Longobardi et al., 2016). In this respect, the implementation of active methodologies is becoming increasingly relevant because these are precisely the methodologies that foster skills-based learning

and thus, must be considered good teaching practice (Arruabarrena et al., 2019). The methodologies in question are best defined as constructivist educational practice based on interaction, and as such are personalized learning experiences that involve students in the process of learning, so improving that process (Erbil, 2020; Bastos et al., 2021; Nguyen et al., 2021). Furthermore, active methodologies favor an active role for students enabling them to become sufficiently competent to take charge of their own learning resulting in deeper, more meaningful and long-lasting learning and as skills set can then be applied in other contexts (March 2006; Murillo, 2007).

Studies show that the type of methodology employed by teachers is a contextual variable, which plays a part in early school leaving (ESL) and as a result academic attainment (González-Pienda, 2003; de Dios and Rico, 2021). Reducing rates of ESL is one of the European Union's priorities, the aim being to bring rates to 10% across the union's member states by 2020 (European Commission, 2013). Regarding the latest available data, the median level of ESL across Europe is 10.6% (European Commission, 2020), while in Spain, this figure is 17.9% (Instituto Nacional de Estadística, 2022). It has also been found that the use of active methodologies in Pre-school Education by promoting more meaningful learning has a positive impact on academic achievement among students (Halili and Razak, 2018; Muntamer et al., 2020).

The use of active methodologies not only has repercussions for academic achievement; indeed, it has also been shown that such approaches are beneficial to student motivation in primary education, compulsory secondary education, and in university education (Gómez et al., 2021). Some of those active methodologies are Project-Based Learning (PBL) and Cooperative Learning (CL). PBL is a technique that allows students to be more creative and think critically (Talib et al., 2018) so that they become more active by presenting learning content in a real-world way and participating in projects that can attract their minds. CL is defined as a methodology where students work in small groups in which individuals have independence in the completion of whatever task they are working on and where the teacher acts as a guide throughout the teaching and learning process (Shinde and Shinde, 2022).

Increased motivation due to the use of active methodologies in pre-school education has additionally been shown to promote student involvement in learning activities (Bizarro et al., 2018). Thus, motivation or lack of it among students is hugely relevant as it represents a personal variable with huge influence over both ESL and academic achievement with good motivation being essential to educational success (Figure 1; Llanga et al., 2019; European Commission, 2020).

Motivation is a psychological construct about which there is little unanimity as to its conceptualization; rather, its description varies depending on the academic discipline within which it is being studied. However, there are certain common characteristics among the various available definitions of motivation. Thus, it is possible to give a generalized description of motivation as an

FIGURE 1
Relationship between academic performance, learning motivation, and teaching methodology.
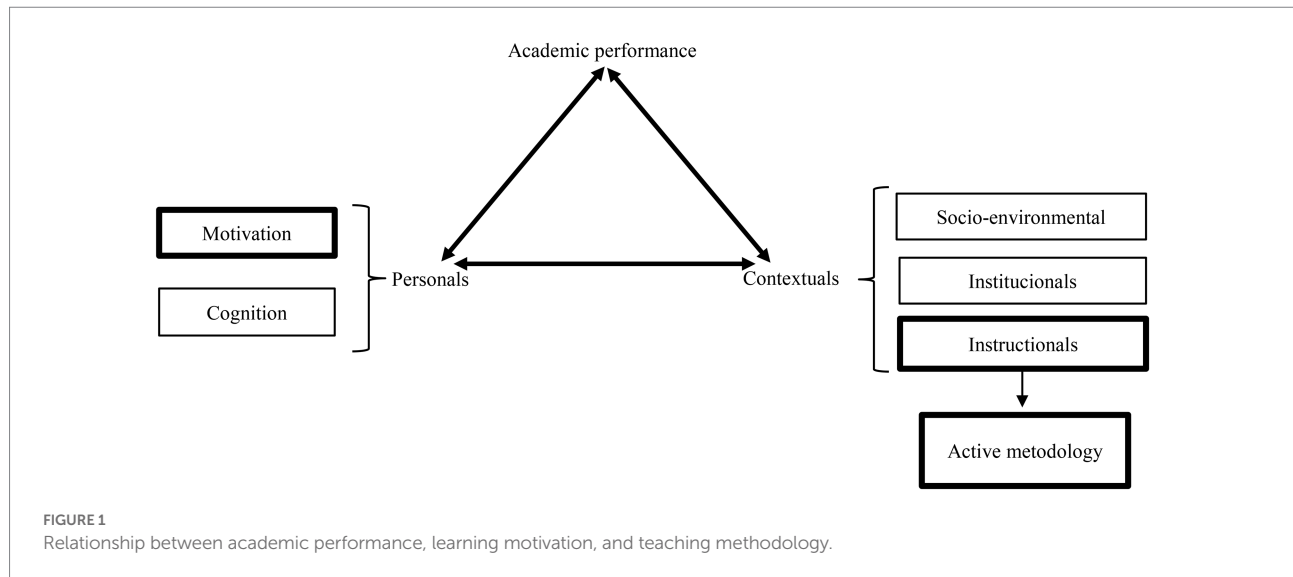
internal, non-observable process composed of a set of internal strengths or personal traits that a given individual will exhibit under a particular stimulus. This leads to the idea of motivation as a dynamic process that drives the activation, direction, and persistence of certain behaviors (Perret, 2016; Armas, 2019). In the framework of self-determination theory (SDT), motivation can be categorized into two types (Ryan and Deci, 2020): intrinsic or extrinsic. The former is characterized as deriving from the individual themselves such that committing to completing a given task is their own decision and motivated purely due to personal interest and pleasure in completing the said task (Prieto, 2020; Swiatczak, 2021). The latter, in contrast, is where an individual commits to completing a given task in order to subsequently obtain some reward or feedback, that is, their activity is instrumental to a separable consequence (di Domenico and Ryan, 2017).

Likewise, motivation is often considered as being determined by a set of components, and as with the definition of motivation itself, there is little consensus as to what these components might be. According to Clark and Saxberg (2018), motivation is composed of three components (Table 1). The first component is "beliefs and expectations" that is the set of perceptions an individual holds, derived from their own sense of self, concerning their ability to complete a given task adequately. This component is considered a good predictor of academic success (Dweck, 1986; De Caso Fuertes and García, 2006; Steinmayr et al., 2019). The second component is "task value," which addresses the individual's orientation to either intrinsic or extrinsic goals (Hasan et al., 2020; Zainuddin et al., 2021). Finally, the third component is "attributions" which concern the perceptions an individual has about the causes of their success or failure in a given task and which are mediated by the individual's emotional state (Wolters and Pintrich, 2001).

Thus, taking into consideration all the elements cited above, learning motivation is best described as the impulse to

TABLE 1 Motivation components.

Components	Dimension
Beliefs and expectations	Competence
Learning value	Utility
Attributions	Cause

persevere in a given behavior in terms of both direction and intensity, to achieve academic success (Colquitt et al., 2000; Talida, 2021). The need to study motivation in the context of learning has been an ongoing topic of interest for many years and this trend continues (Navas and de Caso Fuertes, 2017). This is due to the complex interaction of cognitive and emotional factors at play as well as the significant impact student motivation can have on learning success (Pintrich and de Groot, 1990; Pintrich, 2000).

In summary, the educational system, in Spain as elsewhere in the EU, has undergone significant curricular change and this needs to be addressed through appropriate measures. One such measure is the increased use of active methodologies in classrooms, since teaching based on this approach enables the skills-based learning around which the curricular changes have been based (Organization for Economic Co-operation and Development [OECD], 2019). This type of constructivist methodology fosters motivation and this, in turn, increases students' chances of academic success. In this way, it is necessary to understand more about the long-term impact of active methodologies in pre-school education and their positive influence on motivation inasmuch as these methodologies promote student's holistic development (Villamizar, 2021).

In light of the previous discussion, the specific question tackled in this research is whether the use of active methodologies does indeed promote motivation even in pre-school education.

From this research question, the general objective of this study is to assess the impact of active methodologies with respect to students' intrinsic motivation in the teaching and learning process within a cohort of students in the second cycle of pre-school education (3–6 years old). The importance of this objective lies in improving understanding of how fostering motivation in the early years of education could promote students' interest in learning tasks and thus have positive repercussions in subsequent stages of education perhaps even reducing levels of ESL (European Commission, 2015; Jamilah et al., 2021). Furthermore, reinforcing intrinsic rather than extrinsic motivation implies that students will persevere more in their learning tasks even when their outcomes are not always ideal (Msane et al., 2020). In order to achieve our general objective, we have defined the following specific objectives: (a) to design an instrument specifically to evaluate students' learning motivation in the second cycle of pre-school education; (b) to assess whether there are differences in motivation among students with respect to sex; (c) to assess whether there are differences in motivation among students with respect to age; (d) to assess whether there are differences in motivation among students with respect to the class in which they are taught (class ID); and (e) to assess whether there are differences in motivation among students with respect to the type of school they attend (rural or urban).

3. Materials and methods

3.1. Design

This is a transversal study considering the correlations between two principal variables: on the one hand that of motivation, taking into account all its components; and on the other hand, active methodologies. The instrument used in this investigation produced quantifiable data, thus this is a quantitative study; it is also experimental as it involves the direct manipulation of experimental conditions once the type of classroom methodology was selected. Furthermore, this is a comparative study as it considers differences between three groups: a control group and two experimental groups under two different experimental conditions. The control group experienced a combined methodology comprising traditional methods and PBL. The first of the two experimental groups experienced PBL, while the second experienced a combination of PBL and CL.

It should be noted that, for the purposes of this investigation, traditional methods are defined as those where the teacher follows a rigid lesson plan and students are required to complete well-defined tasks based around this, generally using worksheets. PBL methods include approaches where students work collaboratively on topics linked to real-life contexts and give students an active role in the teaching and learning process (Shin,

2018). Specifically, the teacher proposes a discussion theme, according to the time of the year, and let students to decide what they want to work about that issue; this was the start of the PBL method. CL starts when the teacher divides the class in groups of four students according to their characteristics in order they can help each other to complete the tasks.

3.2. Participants

The corpus was selected by non-probabilistic convenience sampling according to the schools and classes the researcher had access to. The initial corpus comprised 79 students in the second cycle of pre-school education from two publicly funded schools located in the province of León (Spain). Due to the fact that two students in the corpus had Special Educational Needs, they were removed from the sample as their circumstances represented a set of additional variables that would need to be controlled for. This left a corpus of 77 students all in the second cycle of pre-school education. Of the 77 participants in the sample, 9% were in the 1st year of pre-school; 31% in the 2nd year; and 60% in the 3rd year. The cohort had a median age of 57 months and an age range of 3 to 7 years old. 53% of the sample were girls and 47% were boys.

The first center included in the study (center 1) was a publicly funded rural school collective (*Colegio Rural Agrupado*: C.R.A) which can be defined, according to Ponce et al. (2000), as: "organizations based on the grouping together of various units to comprise a school and which can extend across various locations." (pp. 316). The C.R.A. used for this study has three sections used for teaching and learning: section A which had 25 students of which 15 were girls and 10 were boys; section B which had 7 students of which 3 were girls and 4 were boys; and section C which had 10 students of which 6 were girls and 4 were boys.

The second center (center 2) included in this work was a Center for Pre-school and Primary Education (*Centro de Educación Infantil y Primaria*: C.E.I.P.) situated in the provincial capital. Thus, in contrast to the first school, this is an urban center. The total number of participants from this center was 37 of which 17 were girls and 20 were boys (see Table 2).

3.3. Instrument

The Pre-school Learning Motivation Scale (*Escala de Motivación hacia el Aprendizaje Infantil*: EMAPI; Blanco, 2014) was used as the basis for the *ad hoc* questionnaire used in the present study. This instrument was judged to be a suitable theoretical foundation for our own as it was designed especially for use with preschoolers and in addition has been assessed for validity in terms of correlation analysis and construction. Furthermore, the internal consistency of this

TABLE 2 Distribution of participants according to their sex and school.

Schools	Section	Classroom	Methodology	Id Class	Girls	Boys	Total
School 1	Section A	Classroom I	PBL and CL	Clase 4	9	7	16
		Classroom II	PBL and worksheets	Clase 3	6	3	9
School 1	Section B		PBL and worksheets	Clase 5	3	4	5
School 1	Section C		PBL	Clase 6	6	2	8
School 2		Classroom I	PBL	Clase 2	8	10	18
		Classroom II	PBL	Clase 1	9	10	19
Total					41	36	77

FIGURE 2
Sample of a questionnaire item.

TABLE 3 Motivation dimensions in the EMAPI questionnaire.

Dimension	Number of items
Beliefs and expectations	7
Learning value	4
Standard levels	4
Attributions	8

instrument has been assessed giving a reliability of 0.87 (Cronbach's Alpha).

The *ad hoc* questionnaire used in this study is included in Appendix Table A1 and it is intended to measure the variable of student motivation with respect to the teaching methodology. The questionnaire was designed to gather information from the corpus concerning the three components of motivation, that is, beliefs and expectations, task value, and attributions as well as how these are related to the use of particular active methodologies. The instrument used integrates all these components into 27 items measured on a Likert-type scale with three levels: agree, neither agree nor disagree, and disagree. The students in the corpus used for the present study are all at the 'preoperational' stage of their development, thus they can manage tasks with concrete elements but will struggle with abstraction and clearly, the assessment of their motivation must take into account their developmental stage (de Caso Fuertes, 2014). In this way, to evaluate correlations between the variables used in this investigation, various visual aids were used to assist students in their understanding of the items in the study questionnaire, specifically, all items contained an illustrated section (Figure 2) as well as a written one.

The component of motivation associated with beliefs and expectations was assessed in three items (Beliefs1, 2, and 3 corresponding to questionnaire items 3, 6, and 8), for example: "I

can put my coat on by myself." A total for this motivation component was calculated as the sum of scores for each individual belief scores (TotalBeleifs)."

Four items were used to measure students' perceptions of task value (Value 1–4 corresponding to questionnaire items 9, 10, 12, and 13), for example: "*I like going to school because I learn lots of things.*" A total score for this component was calculated as the sum of individual value scores (TotalValue) (see Table 3).

Seven items were used to measure students' perceptions of attributions (Attributions 1–7, corresponding to questionnaire items 14, 15, 16, 17, 18, 19, 20, and 21), for example: "*I know how to write the number 1 because I'm very smart.*" A total score for this component was calculated as the sum of individual value scores (TotalValue).

Two items concerning beliefs and expectations and one concerning task value also measured the motivation of students with respect to active methodologies (Beliefs&pro1, Beliefs&pro2, and Value&pro3, corresponding to questionnaire items 1, 5, and 11), for example: "*It's better to discover things for myself than that my teacher tells me everything.*"

Three items were used to measure motivation in relation to CL methods and students' beliefs and expectations (Beliefs&coo1, Beliefs&coo2 y Beliefs&coo3, corresponding to questionnaire items 2, 4, and 7), for example: "*I feel happy when I work as a team with my classmates.*"

Six items were included to gather together all the information concerning how positively students responded to the use of active methodologies (Coop1, Coop2, Coop3, Project1, Project2, and Project3, corresponding to questionnaire items 22, 23, 24, 25, 26, and 27), for example: "*When I work with my classmates, I help them a lot.*"; "*I like to find things at home that have to do with things we learn in class.*"

3.4. Procedure

Before the start of the investigation, the centers used were contacted to ensure that teachers in the classes that formed the corpus for the present work would be making use of the methodologies of interest so that the study could proceed (traditional methods, PBL, and CL). The classroom implementation of the methodologies forming the focus of this research took place over a period of time from the beginning of the academic year to its end. Thus, to assess the effectiveness of these methodologies, the study questionnaire was completed at the end of the academic year.

Because the corpus for this study comprised under-age individuals and the questionnaire would be administered during school hours, before the study could take place, informed consent was obtained from their families and their schools. Thus, both families and schools were given information about the nature of the study and anonymity was guaranteed for all participants. Once this process was completed, the researcher in charge of administering the questionnaires went into classrooms to make initial contact with participants. Due to the ages of participants, the completion of the questionnaire was presented as a game and was administered face-to-face on an individual basis so that questionnaire items could be explained or even read to students by the researcher. Administration of the questionnaire took place outside the classroom itself in the form of a one-to-one interview and before beginning, the researcher would explain to participants how the questionnaire was to be completed making clear that there were no right or wrong answers. The researcher would then give participants a paper copy of the questionnaire and show them the response options as three emoji faces in different colors representing the different degrees of agreement: "agree," smiling face in green; "neither agree nor disagree," neutral face in orange; and "disagree," angry face in red. The researcher would then carefully read each questionnaire item to ensure that participants understood the question. At the same time, the researcher would show a piece of card on which the three possible responses were shown pictorially. Once the question had been asked, participants were asked to give their response verbally and also indicate the picture on the researcher's card that corresponded to the answer they had given. Wherever necessary, clarifications were made concerning the questionnaire items to ensure that there would be no ambiguities in participants' understanding of questions and thus the investigation's findings would be reliable.

The questionnaire was administered by the same researcher in both centers and all classrooms in order to control for factors such as the researcher's own response to the test situation and those concerned with researcher-participant interactions. Furthermore, to control for factors that might threaten the questionnaire's internal validity, it was administered at the same time of day in all cases.

3.5. Statistical analysis

Statistical analysis of data was carried out using the program IBM SPSS Statistics v.26. Normality was tested using the Lilliefors-corrected Kolmogorov–Smirnov test and for all variables, p-values were less than the significance level of 0.05, indicating that the null hypothesis of normality should be rejected. As a result, data were analyzed using non-parametric methods, specifically the Mann–Whitney U-test and Kruskal–Wallis tests for comparisons between independent samples, and Rosenthal's r for effect size. With regard to this last statistical test, Coolican's (2018) interpretation was used.

4. Results

In the following, the results of the investigation are described looking at the different variables assessed in relation to the specific objectives of the present study. All results shown here had a significance level equal to or less than 0.05 for which the null hypothesis was considered true.

4.1. Motivation components and sex

With respect to the results obtained concerning the relationship between specific motivation components and the variable "sex of participant," statistically significant results were found for five questionnaire items and the variable termed Total value (using the Mann–Whitney U-test, see Table 4). The variation in statistical significance ranged from 0.17 (Project3) to 0.05 (Beliefs1). Comparing median scores for individual questionnaire items, the lowest score recorded for the girls was 41 whereas for the boys it was 37.15. This indicates that girls tended to be more motivated than boys.

The effect strengths calculated through the r of Rosenthal show a negative r in all variables, which means that the second group (girls) is larger than the first one (boys), which it is usual

TABLE 4 Analysis using the Mann–Whitney U-test to evaluate how motivation depends on sex.

	Girls rank	Boys rank	Z	r	*p
Beliefs1 (item 3)	41	37.15	−1.962	−0.224	0.05
Value4 (item 12)	45.86	32.65	−3.134	−0.357	0.002
Atrib7 (item 20)	44	34.38	−2.994	−0.341	0.003
Proyect2 (item 26)	42.45	35.81	−1.995	−0.227	0.046
Proyect3 (item 27)	42.51	35.75	−2.377	−0.271	0.017
Total learning value	44.62	33.8	−2.222	−0.253	0.026

*There are only shown statistically significant results.

talking about educational studies. With respect to the differences seen for four of the variables considered Beliefs1, Project2, Project3, and Total value, the r value calculated was equal to or less than 0.3, thus demonstrating a moderate-small effect size. However, the differences seen for the remaining variables have a range of r values from 0.30 to 5.0, demonstrating a moderate-large effect size.

4.2. Motivation components and age

Concerning the results obtained for motivation components and their relationship to the variable, age of participant, here statistically significant results were found in the case of seven variables (using the Kruskal–Wallis test, see Table 5). In order to complete this analysis participants were split into three age groups: group 1 (41 to 53 months old); group 2 (54 to 66 months); and group 3 (67 to 76 months old).

Results of this analysis showed there were significant differences for 11 significant differences between groups in a total of seven variables (Beliefs2, Value2, Coop1, Coop2, Total value, and Total cooperative) with greatest motivation seen among the oldest group (group 3: children aged 67 to 76 months) in every

case. This group also had the highest scores in all questionnaire items compared to other age groups. However, to verify precisely between which groups statistically significant differences existed, further *post-hoc* analysis was completed using the Mann–Whitney U-test (Table 6). This demonstrated that group 2 and group 3 showed statistically significant differences for all seven variables previously identified (4 questionnaire items and 3 total scores), while groups 1 and 3 showed statistically significant differences in only four of these variables (1 questionnaire item and 3 total scores). No statistically significant differences were observed between groups 1 and 2 (children aged 41–53 months and those aged 54–66 months).

Effect sizes (calculated as Rosenthal's r) were once again negative since group 3 was larger than either group 1 or group 2. For seven of the 11 statistically significant differences found, effect sizes were moderate or moderate-high with r > 0.3 (comparing groups 1 and 3 for the variables Coop1 and Total PBL and comparing groups 2 and 3 for the variables Value2, Coop1, Coop2, Total value, and Total cooperative). In contrast, for the remaining differences, small or small-moderate effect sizes were found (comparing groups 1 and 3 for the variables Total value and Total cooperative and comparing groups 2 and 3 for Beliefs2 and Total PBL).

4.3. Motivation components and class ID

For this analysis, the corpus was divided into groups according to class ID. This gave a total of 6 class ID groups (see Table 6): group 1 (center 2, classroom I, class 2); group 2 (center 2, classroom II, class1); group 3 (center 1: section A, classroom I, class 4); group 4 (center 1: section A, classroom II, class 3); group 5 (center 1: section B, class 5); and group 6 (center 1: section C, class 6).

Results of analysis using the Kruskal–Wallis test show that there were significant differences for 16 variables with respect to class ID (11 questionnaire items and 5 total scores) with significance levels varying from 0.000 to 0.04 (see Table 7).

TABLE 5 Kruskal–Wallis analysis to evaluate how motivation depends on age.

	Group 1 rank	Group 2 rank	Group 3 rank	*p
Beliefs2 (item 6)	43.15	35.18	44.7	0.041
Value2 (item10)	40.73	34.13	48.6	0.017
Coop1 (item 22)	37.23	32.32	54.85	0
Coop2 (item 23)	43.81	33.65	47.65	0.006
Total learning value	34.46	34.74	51.33	0.011
Total PBL	30.31	36.6	49.93	0.012
Total cooperative	36.73	32.92	53.85	0.002

*There are only shown statistically significant results.

TABLE 6 *Post-hoc* Mann–Whitney *U*-test analysis to evaluate how motivation depends on age.

		Beliefs2 (item 6)	Value2 (item 10)	Coop1 (item 22)	Coop2 (item 23)	Total value	Total PBL	Total cooperative
Group 1 vs. 3	U			75.000		72.500	63.000	67.000
	Z			−2.841		−2.318	−2.872	−2.506
	r			−0.324		−0.264	−0.327	−0.286
	*p			0.005		0.020	0.004	0.012
Group 2 vs. 3	U	330.000	275.500	178.000	280.500	251.000	288.500	206.000
	Z	−2.211	−2.797	−4.244	−2.895	−2.878	−2.498	−3.468
	R	−0.252	−0.319	−0.484	−0.330	−0.328	−0.285	−0.395
	*p	0.027	0.005	0.000	0.004	0.004	0.012	0.001

*There are only shown statistically significant results.

	1	2	3	4	5	6	*p
Beliefs&coo1 (item 2)	28.18	50.11	45.94	36.22	21.79	52.50	0.000
Beliefs&pro2 (item 5)	28.42	40.61	38.78	42.38	47.00	47.00	0.021
Beliefs2 (item 6)	29.37	40.50	42.50	39.75	46.50	46.50	0.040
Value1 (item 9)	63.24	30.08	41.67	43.78	46.50	46.50	0.035
Value2 (item 10)	38.68	18.67	44.61	47.00	52.00	51.81	0.000
Value4 (item 12)	41.47	27.56	37.11	39.50	52.00	48.63	0.024
Value5 (item 13)	46.05	17.44	45.67	40.50	47.29	53.00	0.000
Atrib2 (item 15)	32.26	50.33	18.89	38.75	58.00	36.00	0.000
Atrib8 (item 21)	41.32	40.89	21.83	39.13	49.50	39.13	0.038
Coop1 (item 22)	26.66	26.19	52.83	43.88	56.50	56.50	0.000
Coop2 (item 23)	38.66	20.14	45.39	47.19	49.50	49.50	0.000
Total Beliefs	21.63	45.97	44.28	37.72	39.79	60.50	0.000
Total value	41.76	18.17	44.50	39.88	55.79	56.69	0.000
Total atrib	35.95	49.97	16.22	30.63	59.29	46.19	0.000
Total PBL	28.66	37.33	42.50	35.25	56.00	56.00	0.006
Total cooperative	24.97	28.94	50.17	45.84	42.07	66.00	0.000

*There are only shown statistically significant results.

Once it had been established that significant differences existed between groups, a further *post-hoc* analysis was completed using the Mann–Whitney *U*-test to determine the specific pairs of groups between which these differences occurred (Tables 8, 9). These tests confirmed the existence of significant differences for the 16 variables highlighted in the previous analysis. The following sections will outline the differences existing between class ID groups first in relation to the 11 questionnaire items and secondly in relation to the 5 total scores.

4.3.1. Motivation components in terms of questionnaire item and class ID

Where statistically significant differences were found between groups, it was necessary to refer to the scores in Table 7 in order to identify which of the two groups being compared demonstrated the greater degree of motivation. It is noteworthy that the variables shown in Table 8 all correspond to individual questionnaire items.

For all of the following, refer to Table 8.

Considering differences between groups 1 and 2, here statistically significant differences were found for seven questionnaire items. In the case of items related to both beliefs and expectations, and attributions, group1 demonstrated more motivation than group 2. However, for components of motivation connected with task value and CL, group 2 was the more motivated group.

Groups 1 and 3 showed statistically significant differences for four items. Differences related to the motivation component, beliefs, and expectations, and to CL all showed group 3 to be most

motivated while for differences related to the component, attributions, group 1 appeared to be most motivated.

Concerning groups 1 and 4, two items showed statistically significant differences. For both of these (Beliefs&pro2 and Coop1), group 4 was seen to be most motivated.

Differences were found between groups 1 and 5 for four items. For all four of these (Beliefs&pro2, Beliefs2, Atrib2, and Coop2), group 5 was the more motivated group.

With respect to groups 1 and 6, statistically significant differences were found for four items (Beliefs&coop1, Beliefs&pro2, and Beliefs2 y Coop1). In all cases, group 6 was seen to be the more motivated group.

Classes 2 and 3 showed statistically significant differences for six variables. Here, all differences concerning items related to attributions showed group 2 to be more motivated while the differences seen concerning items related to task value and CL showed group 3 was the more motivated of these two groups.

Concerning differences between groups 2 and 4, statistically significant differences were found for six items. For one item, Beliefs&coo1, group 2 was shown to be more motivated while for items related task value and CL group 4 appeared to be most motivated.

For groups 2 and 5, differences were found for seven items. Concerning the item Beliefs&coo1, here group 2 was more motivated. For the other six items, which related to the motivation components of task value and attributions, as well as several concerning CL, group 5 was shown to be most motivated.

TABLE 8 *Post-hoc* Mann–Whitney *U*-Test analysis to evaluate how motivation depends on class ID I.

		Beliefs&coo1	Beliefs&pro2	Beliefs2	Value1	Value2	Value4	Value5	Atrib2	Atrib8	Coop1	Coop2
clase 1–2	U	74.5	117			76.5	111.5	39	77			94.5
	Z	−3.475	−1.994			−3.260	−2.106	−4.518	−3.100			−2.592
	r	−0.396	−0.227			−0.372	−0.240	−0.515	−0.353			−0.295
	*p	0.001	0.046			0.001	0.035	0.000	0.002			0.010
clase 1–3	U	42.5							41	43.5	29	
	Z	−2.304							−2.392	−2.466	−3.001	
	r	−0.263							−0.273	−0.281	−0.342	
	*p	0.021							0.017	0.014	0.003	
clase 1–4	U		96.5								94	
	Z		−2.253								−2.082	
	r		−0.257								−0.237	
	*p		0.024								0.037	
clase 1–5	U		35	38.5					14		17.5	
	Z		−2.174	−1.992					−3.250		−3.052	
	r		−0.248	−0.227					−0.370		−0.348	
	*p		0.030	0.046					0.001		0.002	
clase 1–6	U	28	40	44							20	
	Z	−2.849	−2.307	−2.116							−3.220	
	r	−0.325	−0.263	−0.241							−0.367	
	*p	0.004	0.021	0.034							0.001	
clase 2–3	U					24		19	19	34.5	17.5	26.5
	Z					−3.403		−3.773	−3.614	−2.716	−3.791	−3.187
	r					−0.388		−0.430	−0.412	−0.309	−0.432	−0.363
	*p					0.001		0.000	0.000	0.007	0.000	0.001
clase 2–4	U	90.5			92.5	42		61			82	40.5
	Z	−2.490			−2.305	−4.062		−3.401			−2.331	−4.106
	r	−0.284			−0.263	−0.463		−0.388			−0.266	−0.468
	*p	0.013			0.021	0.000		0.001			0.020	0.000
aula 2–5	U	21.5			35	10.5	24.5	16			7	14
	Z	−3.393			−2.079	−3.742	−2.708	−3.518			−3.944	−3.368

(Continued)

TABLE 8 (Continued)

		Beliefs&coo1	Beliefs&pro2	Beliefs2	Value1	Value2	Value4	Value5	Atrib2	Atrib8	Coop1	Coop2
	r	−0.387			−0.237	−0.426	−0.309	−0.401			−0.449	−0.384
	*p	0.001			0.038	0.000	0.007	0.000			0.000	0.001
aula 2–6	U				40	12	31.5	8			8	16
	Z				−2.206	−3.805	−2.565	−4.216			−4.100	−3.528
	r				−0.251	−0.434	−0.292	−0.480			−0.467	−0.402
	*p				0.027	0.000	0.010	0.000			0.000	0.000
aula 3–4	U								39.5	42		
	Z								−2.167	−2.000		
	r								−0.247	−0.228		
	*p								0.030	0.046		
aula 3–5	U	11							3.5	10.5		
	Z	−2.437							−3.416	−2.646		
	r	−0.278							−0.389	−0.302		
	*p	0.015							0.001	0.008		
aula 3–6	U											
	Z											
	r											
	*p											
aula 4–5	U								31.5			
	Z								−2.052			
	r								−0.234			
	*p								0.040			
aula 4–6	U	36										
	Z	−2.145										
	r	−0.244										
	*p	0.032										
aula 5–6	U	8										
	Z	−2.828										
	r	−0.322										
	*p	0.005										

*There are only shown statistically significant results.

With respect to groups 2 and 6, six variables showed statistically significant differences. These items concerned task value and CL, and, in every case, group 6 was shown to be most motivated.

Groups 3 and 4 demonstrated differences for two items, both related to the motivation component of attributions. In both cases, group 4 showed more motivation than group 3.

Concerning groups 3 and 5, here statistically significant differences were seen for three items. The item Beliefs&coo1 showed that group 3 was more motivated; however, for the other two items, both concerning attributions, group 5 appeared to be most motivated.

Groups 4 and 5 showed differences for the item Atrib2 and this showed group 5 to be the more motivated group.

Finally, comparing groups 4 and 6, and groups 5 and 6. In both cases, statistically significant differences occurred for the item, Beliefs&coo1, and both comparisons showed group 6 to be the more motivated group.

Effect sizes (calculated as Rosenthal's r) were negative in all cases reflecting the fact that group 6 was the largest. Analysis shows that there was a large effect size in one instance, Value5, comparing groups 1 and 2, with $r > 0.5$. For 30 other statistically significant differences found, the effect sizes would be considered moderate-large with $r > 0.3$, while the remaining 23 significant differences had small-moderate effect size, with $r < 0.3$.

4.3.2. Motivation components in terms of total scores and class ID

For the following, refer to Table 9.

With respect to groups 1 and 2, statistically significant differences were seen for three total scores: task value, beliefs and expectations, and attributions. Concerning the first of these, results showed that group 1 were more motivated and concerning the latter two, here group 2 appeared most motivated.

Comparing groups 1 and 3, in this case, statistically significant differences were seen for three total scores. For attributions, group 1 appeared more motivated while for the components, beliefs and expectation, and CL, group 3 was the more motivated group.

Concerning groups 1 and 4, statistically significant differences were found for two total scores, specifically those of beliefs and expectations, and CL. In both instances, group 4 was shown to be most motivated.

For groups 1 and 5, statistically significant differences were found for two total scores: attributions and PBL. In both cases group 5 was most motivated.

With respect to the differences between groups 1 and 6, here statistically significant differences were found for three total scores: beliefs and expectations, PBL, and CL. In all cases, group 6 was seen to be most motivated.

Groups 2 and 3 showed statistically significant differences in three total scores. In the case of attributions, group 2 appeared more motivated while in the case of the totals for task value and CL, the situation was reversed, and group 3 seemed to be most motivated.

Concerning the comparison of groups 2 and 4, here statistically significant differences were found for three total scores. With respect to the total for attribution, group 2 was more motivated; however, the totals for task value and CL showed group 4 to be most motivated.

With respect to groups 2 and 5, statistically significant differences were found for two total scores: task value and PBL. In both cases, group 5 appeared to be most motivated.

Comparing groups 2 and 6, statistically significant differences were found for four total scores, specifically, beliefs and expectations, task value, PBL, and CL. In all instances, group 6 was seen to be the most motivated group.

Turning to the comparison of groups 3 and 4, here statistically significant differences were found only in the total score for attributions with class 4 showing most motivation.

With respect to groups 3 and 5, statistically significant differences were found once again in the total score for attributions with class 5 showing most motivation.

For groups 3 and 6, statistically significant differences were found for three total scores: beliefs and expectations, attributions, and CL and group 6 was most motivated in terms of all these components.

With respect to groups 4 and 5, statistically significant differences were found for two total scores. These were attributions and PBL and results showed that group 5 was more motivated.

Concerning groups 4 and 6, statistically significant differences were found for four total scores: beliefs and expectations, task value, PBL, and CL. In all cases, group 6 was most motivated.

Lastly, in the comparison between groups 5 and 6, statistically significant differences were found for two total scores, specifically, beliefs and expectations, and CL. In all cases, group 6 was shown to be most motivated.

As before, effect sizes (calculated as Rosenthal's r) were negative in all instances. Effect sizes were calculated in 19 instances with $0.30 < r < 0.50$. However, for 19 of the significant differences found, the effect size would be considered small-moderate with $0.10 < r < 0.30$.

4.4. Motivation components and teaching methodology

Here analysis centered on whether or not motivation appeared to correlate with the teaching methodology used in the classroom. Segmenting the data according to teaching methodology gave three groups: group 1 (PBL); group 2 (PBL + traditional); and group 3 (PBL + CL). Results showed there to be statistically significant differences for seven variables (using the Kruskal–Wallis test, see Table 10).

Statistically significant differences between groups were found for questionnaire items measuring motivation based on the use of PBL and CL, specifically, Value&pro3; Coop1; and Coop2 with significance levels between 0.000 and 0.048. It should be noted that in the case of items that referred purely to CL,

TABLE 9 *Post-hoc* Mann−Whitney *U*-Test analysis to evaluate how motivation depends on class ID II.

		Total beliefs	Total value	Total atrib	Total PBL	Total cooperative
clase 1–2	U	65.5	66	101		
	Z	−3.284	−3.245	−2.192		
	r	−0.374	−0.370	−0.250		
	*p	0.001	0.001	0.028		
clase 1–3	U	33.5		38		33.5
	Z	−2.597		−2.384		−2.598
	r	−0.296		−0.272		−0.296
	*p	0.009		0.017		0.009
clase 1–4	U	87				66.5
	Z	−2.187				−2.907
	r	−0.249				−0.331
	*p	0.029				0.004
clase 1–5	U			21.5	24.5	
	Z			−2.683	−2.645	
	r			−0.306	−0.301	
	p			0.007	0.008	
clase 1–6	U	4			28	4
	Z	−3.923			−2.802	−3.919
	r	−0.447			−0.319	−0.447
	*p	0.000			0.005	0.000
clase 2–3	U	76	27	15.5		37
	Z	−0.289	−2.804	−3.465		−2.306
	r	−0.033	−0.320	−0.395		−0.263
	*p	0.772	0.005	0.001		0.021
clase 2–4	U		53.5	71.5		73
	Z		−3.170	−2.588		−2.574
	r		−0.361	−0.295		−0.293
	*p		0.002	0.010		0.010
aula 2–5	U		5		28	
	Z		−3.567		−2.400	
	r		−0.406		−0.274	
	*p		0.000		0.016	
aula 2–6	U	44	4.5		32	8
	Z	−1.994	−3.788		−2.545	−3.692
	r	−0.227	−0.432		−0.290	−0.421
	*p	0.046	0.000		0.011	0.000
aula 3–4	U			37		
	Z			−2.041		
	r			−0.233		
	*p			0.041		
aula 3–5	U			1		
	Z			−3.315		
	r			−0.378		
	*p			0.001		

(Continued)

TABLE 9 (Continued)

		Total beliefs	Total value	Total atrib	Total PBL	Total cooperative
aula 3–6	U	20		9.5		16
	Z	−2.069		−2.617		−2.397
	r	−0.236		−0.298		−0.273
	*p	0.039		0.009		0.017
aula 4–5	U			14	24.5	
	Z			−2.906	−2.399	
	r			−0.331	−0.273	
	*p			0.004	0.016	
aula 4–6	U	28	33.5		28	24
	Z	−2.412	−2.006		−2.543	−2.700
	r	−0.275	−0.229		−0.290	−0.308
	*p	0.016	0.045		0.011	0.007
aula 5–6	U	8				8
	Z	−2.828				−2.828
	r	−0.322				−0.322
	*p	0.005				0.005

*There are only shown statistically significant results.

TABLE 10 Kruskal−Wallis analysis to evaluate how motivation depends on the teaching methodology used.

	1	2	3	*p
Value2 (item 10)	33.01	47.84	47.00	0.004
Valueypro3 (item 11)	40.24	43.38	31.13	0.048
Atrib1 (item 14)	43.11	36.19	30.25	0.048
Atrib4 (item17)	40.31	42.60	32.31	0.013
Coop1 (item 22)	31.78	54.44	43.88	0.000
Coop2 (item 23)	33.18	47.19	47.19	0.002
Total Cooperative	33.86	46.63	45.84	0.048

*There are only shown statistically significant results.

statistically significant differences were found for all three groups (significance values = 0.048).

To determine precisely how the groups compared, a *post hoc* analysis was completed using the Mann–Whitney *U*-test (Table 11) and this demonstrated 11 instances of statistically significant difference. Comparing groups 1 and 2, statistically significant differences were found for three variables, all showing group 2 to be most motivated. In the case of groups 1 and 3, statistically significant differences were found for 6 variables (5 questionnaire items and one total score) and while three (Value&pro3, Atrib1, and Atrib4) showed group 1 to be most motivated, the other three (Value2, Coop2, and Total cooperative) showed group 2 to be the more motivated group. Considering groups 2 and 3, here statistically significant differences were found for two variables (Value&pro3 and Atrib4) with group 2 shown to be most motivated in both cases.

The effect sizes (calculated as Rosenthal's r) were again negative in all instances. Effect size was medium-large in one case (Coop1), with r > 0.30. However, medium-small effect sizes were calculated in all other cases of statistically significant difference with r in a range between 0.10 and 0.30.

4.5. Motivation components and type of center

Concerning the relationship between motivation components and the type of center attended by participants (either an urban or rural school in this case). Thus, the corpus was divided according to which school center participants attended, either the urban (group 1) or rural (group 2) school and results obtained through an analysis using the Mann–Whitney *U*-test indicated that 11 of the variables tested here showed statistically significant differences (Table 12). It was shown that group 2 was more motivated than group 2 since, in all cases where statistically significant differences were found, group 2 always obtained the higher score.

Effect sizes (calculated as Rosenthal's r) were negative in all cases, reflecting the fact that the rural school group (group 2) was larger than the urban school group (group 2). In the case of differences seen for 4 of the variables (Value2, Coop1, Coop2, and Total cooperative), the effect size would be considered large, with r > 0.50. In the case of five variables (Value1, Value5, Coop3, and Project2 and Total value), the differences found had effect sizes that would be considered medium-large with 0.30 < r < 0.50, while differences seen for the remaining variables demonstrated small effect size with 0.10 < r < 0.30.

TABLE 11 *Post-hoc* Mann–Whitney *U*-Test to evaluate how motivation depends on teaching methodology.

		Value2 (item 10)	Value&pro3 (item 11)	Atrib1 (item 14)	Atrib4 (item 17)	Coop1 (item 22)	Coop2 (item 23)	Total cooperative
Grupo 1–2	U	219.5				139	229	
	Z	−2.625				−4.004	−2.615	
	r	−0.299				−0.456	−0.298	
	*p	0.009				0.000	0.009	
Grupo 1–3	U	231	273	240	285		229	243.5
	Z	−2.419	−1.997	−2.460	−2.381		−2.615	−1.956
	R	−0.276	−0.228	−0.280	−0.271		−0.298	−0.223
	*p	0.016	0.046	0.014	0.017		0.009	0.050
Grupo 2–3	U		89		96			
	Z		−2.039		−2.101			
	r		−0.232		−0.239			
	*p		0.041		0.036			

*There are only shown statistically significant results.

TABLE 12 *U* Mann–Whitney analysis to assess how motivation is affected by center type.

	1	2	Z	r	*p
Beliefs&coo2 (item 5)	34.35	43.3	−2.481	−0.283	0.013
Beliefs2 (item 6)	34.78	42.9	−2.306	−0.263	0.021
Value1 (item 9)	33.24	44.33	−3.149	−0.359	0.002
Value2 (item 10)	28.95	48.3	−4.483	−0.511	0.000
Value4 (item 12)	34.7	42.58	−1.962	−0.224	0.050
Value5 (item 13)	32.14	45.35	−3.077	−0.351	0.002
Coop1 (item 22)	26.43	50.63	−5.285	−0.602	0.000
Coop2 (item 23)	29.65	47.65	−4.544	−0.518	0.000
Coop3 (item 24)	34.51	43.15	−2.687	−0.306	0.007
Project2 (item 26)	34.07	43.56	−2.855	−0.325	0.004
Project3 (item 27)	35.12	42.59	−2.624	−0.299	0.009
Total beliefs	33.47	44.11	−2.181	−0.249	0.029
Total value	30.28	47.06	−3.446	−0.393	0.001
Total PBL	32.88	44.66	−2.547	−0.290	0.011
Total cooperative	26.91	50.19	−4.694	−0.535	0.000

*There are only shown statistically significant results.

5. Conclusion and discussion

The objective of this study was "*to assess the impact of using active methodologies on the intrinsic motivation of students in the second cycle of pre-school education (3–6 years) towards the process of teaching and learning*." With reference to this general aim, the findings of this study are that the use of active methodologies in the process of teaching and learning in pre-school education does indeed improve learning motivation among students. It is necessary to recall that the areas of study in Pre-school are not well differenced

so that motivation that PBL improves is general academic motivation in this sample. Results of this study show the importance of incorporating active learning methodologies at the pre-school stage of education to foster learning motivation among students as good learning motivation also promotes students' overall development (Abeles et al., 2017). To further emphasize the importance of active methodologies, it has been shown that students in this early phase of education are particularly predisposed toward active learning methodologies (Ansari et al., 2019).

Using a specially designed *ad hoc* questionnaire, this investigation was able to quantify the motivation of students in the second phase of pre-school education. To account for the developmental stage of the students participating in this study, a particular feature of this questionnaire was the use of both written and pictorial elements. It should also be mentioned that questionnaires were administered on a one-to-one basis to facilitate the understanding of all its items and ensure that students did not copy one another.

Our findings demonstrate the existence of a correlation between learning motivation and sex, specifically, girls appear more motivated than boys. This result is in agreement with those of Aljohani and Alajlan (2020) and several factors have been cited to explain this phenomenon. On the one hand, it could be the effect of biases even in these early stages of development which prevent the achievement of equality in education (Su et al., 2022), or on the other hand, as suggested by Rusillo (2017), academic goals, causal attributions, and learning strategies all vary according to sex hence giving rise to differences in levels of motivation between boys and girls.

Findings also show a relationship between age and levels of learning motivation. In the present study, students in the age bracket 67 to 76 months (3rd year of pre-school in Spain) demonstrated higher levels of motivation compared to students in either of the two younger age brackets assessed and differences

were statistically significant. This result coincides with the findings of a study by Gottfried et al. (2001), which concluded that the intrinsic motivation of students increases until the ages of 10–11 years after which it begins to decrease.

Considering the type of classroom in which students were taught (class ID), here, two classes, in particular, showed higher degrees of learning motivation among students compared to other classes. One of the highly motivated classes was taught using PBL and this result agrees with the findings of research by Shin (2018), showing that the use of active methodologies was beneficial to learning motivation. Here, it is also interesting to note that PBL has been proven to foster the development of interpersonal skills and a good attitude to learning (Shin, 2018; Shinde and Shinde, 2022). The other highly motivated class was that in which traditional methods were used in conjunction with PBL. This finding is in line with those of Manchado Cardoso et al.'s (2021) study.

Concerning the influence on learning motivation of the type of methodology implemented in the classroom, here students taught using a combination of traditional worksheets and PBL showed the highest levels of motivation. In this regard, it must be said that the traditional worksheet methods used in the classrooms examined for the present study were integrated with the PBL being implemented at the same time. As a result, the findings presented here tend to reaffirm the idea that active methodologies make a positive impact on students' learning motivation, enhancing interest in learning and in the task (Manzano-León et al., 2022). It would seem then that the combination of two methods with a focus on student-centered active methodologies increases learning motivation and also academic achievement, a phenomenon that has been observed in the case of university students who experienced a combination of active and traditional methods (Pérez-Poch et al., 2019; Manchado Cardoso et al., 2021). Leading from this, one conclusion would be that when resources deemed to be traditional are used in innovative ways, both in terms of how they are used and where they are applied, this can have a positive impact on students' learning motivation.

Turning to consider the effect on learning motivation of the type of center—rural or urban—where participants were taught, here it was found that students attending the rural school were more motivated than those attending the urban school. This result is in line with a study completed by de Caso Fuertes (2017) and is potentially down to three factors. Firstly, it has been shown that rural schools tend to construct positive relations between the teacher and their students which, in turn, fosters an environment of trust so increasing levels of learning motivation among students (Hardré and Sullivan, 2008). The second factor lies in the increased ability of rural schools to individualize the education students receive due to the links created between teachers and students. This enables teachers to get to know their students better and thus they can adjust their teaching to the needs of each student (Ylimaki et al., 2020). The third and final factor concerns the fact that where students find themselves in a learning environment where they do not feel under pressure, their self-esteem is bolstered and this has a positive impact on their intrinsic motivation since it allows them

to see their skills in a positive light (Liukkonen et al., 2010; Halvari et al., 2011). The findings presented here go further than those of previous studies in that while other studies have focused on demonstrating the positive effects of active methodologies on learning motivation in primary education, compulsory secondary education, and university education (Gómez et al., 2021; Mula-Falcón et al., 2022), this work shows that such methods are beneficial even at the earliest stages of education.

Very few empirical studies exist concerning the pre-school phase of education, perhaps due to the difficulties of objectively assessing the youngest learners in terms of such abstract concepts as learning motivation. Thus, the results presented here make a significant contribution to the field of educational research since they clearly indicate the importance of using active methodologies from the very beginning of students' educational journey. The three main contributions of this work can be summarized as follows: firstly, helping to improve the methodological practices of pre-school teachers by showing the overall positive value of active methodologies; secondly, reaffirming the importance of the teaching environment as, one might say, the third agent in the teaching and learning process by highlighting how it is not only the methodology implemented that can make a difference to motivation but also the classroom environment; and thirdly providing an insight into a methodological approach that can be implemented in subsequent stages of the educational process with the aim of ensuring that students' learning motivation does not decrease, and more specifically avoiding reductions in students' intrinsic motivation in favor of extrinsic motivation as is shown to occur for students over the age of 11 years (Gottfried et al., 2001; Lieury and Fenouillet, 2016).

6. Limitations and strengths

The present study has three main limitations: (1) although the sample size used for this work was large, we are aware that it could have been broader allowing us to generalize our conclusions to the wider population of infants receiving pre-school education; (2) we were unable to find a classroom that used only traditional methodologies to assess the effectiveness of such methods when used on their own. Although this is a limitation of the present study, it also reflects an evolution in terms of educational methodologies toward more constructivist approaches in line with recent changes in the relevant legislation; (3) it would have been informative to complete a base-line test of learning motivation at the beginning of the academic year. This would be useful firstly to assess changes in learning motivation and secondly to test the assumption we made in the present study that because all participants were pre-school students at a similar developmental stage, no fundamental differences existed between them.

As future lines of investigation, we suggest first that this study be repeated with a larger corpus and taking into account a wider range of teaching methodologies. Secondly, it would be interesting

to complete a longitudinal study including a control group and two experimental groups with the questionnaire administered both at the beginning of the academic year and at the end such that changes in motivation between the beginning and the end of the year could be assessed as well as differences in motivation between groups. Another interesting line of investigation would be to analyze how PBL changes motivation in different areas of study, what can be probed in Primary studies as they have well-defined areas as language, maths, and sciences, etc.

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.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

YV: concept and questionnaire implementation. YV and AC: methodology, questionnaire design, results, resources, and writing-original draft. AC: validation, formal analysis, and review. All authors contributed to the article and approved the submitted version.

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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Appendix

TABLE A1 Questionnaire items.

Item	Motivational component/ methodology	Variable name
1. I would rather see a tree than have to draw it as the teacher tells me.	Beliefs and expectations	Beliefs&pro1
2. I learn more when I work with my colleagues than when I work alone.	Beliefs and expectations	Beliefs&coo1
3. I can wear my coat by myself.	Beliefs and expectations	Beliefs1
4. I feel happy when I work as a team with my colleagues.	Beliefs and expectations	Beliefs&coo2
5. I would rather have the teacher tell me what a castle looks like if we go on a field excursion to see it, than have her explain it to me with a drawing.	Beliefs and expectations	Beliefs&pro2
6. I like to show my work to my teacher.	Beliefs and expectations	Beliefs2
7. I get happy when I say a poem well to my classmates.	Beliefs and expectations	Beliefs&coo3
8. I can put my backpack just fine, as the teacher tells me.	Beliefs and expectations	Beliefs3
9. I like going to school because I learn a lot of things.	Learning value	Value1
10. It is more important to go to school or to the park.	Learning value	Value2
11. It is more important for me to figure things out or for the teacher to tell me	Learning value	Value&pro3
12. It is more important to draw or play.	Learning value	Value4
13. It is more important to write or draw.	Learning value	Value5
14. I put my coat on the hanger wrong because I cannot.	Attributions	Atrib1
15. I am out coloring by chance.	Attributions	Atrib2
16. I jump well on one leg because I make an effort.	Attributions	Atrib3
17. I know how to write the number 1 because I am smart	Attributions	Atrib4
18. I do well in construction because I try it many times.	Attributions	Atrib5
19. I wash my hands well because I want to.	Attributions	Atrib6
20. I pick up the materials and toys I use because it is easy to.	Attributions	Atrib7
21. I do not eat all my snacks at school because it's hard to eat alone.	Attributions	Atrib8
22. I know how to tell my colleagues what I think	CL	Coop1
23. When I work with my colleagues I help them a lot.	CL	Coop2
24. When I work in a group, my colleagues help me.	CL	Coop3
25. I learn a lot in class when we work on a topic (e.g., the Middle Ages. animals, pirates, etc.).	PBL	Project1
26. I like to look things up at home about what we are dealing with in class.	PBL	Project2
27. I like my classmates and the teacher to tell me things about what we are working on in class.	PBL	Project3