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The Meaning of School program: A controlled before-after study enhancing growth mindset in priority education schools

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ABSTRACT

Objective: Experiences at school have an impact on youths' development, global quality of life, and life trajectory. The "Meaning of School" program adopts a collaborative approach to enhance students' motivation and satisfaction at school. It fosters a growth mindset and aligns learning with students' personal interests and values, drawing from the Self-Determination Theory. This study aims to evaluate the program's effectiveness in improving school motivation and satisfaction by meeting the students' fundamental psychological needs for autonomy and competence and increasing growth mindset.

Methods: The intervention offered to students aged 9 to 11 the opportunity to become aware of their role as students, the importance of education, and their potential contribution to the world by encouraging them to reflect both together and individually. The intervention was proposed in ten schools in France, including those in 'Priority Education Networks' (Réseau d'Éducation Prioritaire), a French initiative that designates schools in underserved or low-income areas with additional resources and support to address educational inequalities. The study encompassed 311 students (4th and 5th grades), divided into experimental and control groups, and employed a mixed-methods approach, integrating quantitative analyses through pre- and post-program questionnaires and qualitative insights from semi-structured interviews.

Results: Quantitative results revealed a significant impact of the workshop on the growth mindset of students, while other measures like motivation, satisfaction, and classroom climate showed no significant changes. Qualitative data, however, highlighted improvements in classroom climate, motivation, and positive school-related emotions post-intervention. Students reported enhanced sense of belonging, perception of intelligence, and a shift towards viewing mistakes as learning opportunities.

Conclusion: The study underscores the possibility of school-based interventions to foster a growth mindset, which can be an important dimension to improve academic engagement and success. It suggests the potential for such programs to contribute to academic perseverance and overall student well-being. Future research may focus on long-term effects, incorporate teacher perspectives, and explore broader application in varied educational settings.

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Introduction

Experiences at school have an impact on youths' development, global quality of life, and life trajectory [1]. Student mental health and well-being problems, and potential consequences such as school dropout, has become a major concern in France, emphasizing the need to address this widespread issue [2]. This national priority reflects a focused attention on students who may prematurely leave the educational system, attend school without motivation, or do so with apprehension. Currently, researchers are increasingly focusing

on processes related to academic perseverance, aiming to include at-risk students and intervene before dropout occurs [3]. This approach seeks to shift the focus from the often negative and reactive perspective associated with dropout to a more preventive and constructively oriented view of the educational experience. In this vein, the program The Meaning of School ("Le Sens de l'École[®]") focuses on enhancing students' sense of belonging at school, improving the meaning of school, and promoting a sense of competence, notably through the development of a growth mindset.

Allowing students to own their educational journey while fostering a growth mindset about their abilities can increase the satisfaction of their basic psychological needs (autonomy, competence and relatedness), and thus enhance their school motivation and satisfaction, as highlighted by research based on the Self-Determination Theory [4]. This theory posits natural, proactive human tendencies

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towards learning, mastery, and connection with others [5], asserting that this dynamic can be nurtured by supporting basic psychological needs. The need for autonomy reflects control over one's actions, bolstered by personal interest and meaning, and diminished by external constraints. The need for competence manifests as a sense of efficacy and progress, thriving in stimulating and supportive environments. The need for relatedness involves feelings of belonging and connection, nurtured by mutual respect and care [6]. The "Meaning of School" program aims to help students understand how academic learning aligns with their personal interests and values. This approach addresses the need for autonomy and fosters intrinsic motivation, defined by Ryan and Deci as engaging in activities for inherent interest and enjoyment. A meta-analysis underscores the importance of this motivation for academic motivation, satisfaction and success [7]. However, schools in France are often criticized for not fostering an environment conducive to this motivation, instead imposing rigid learning methods that limit student autonomy, favoring extrinsic or controlled motivation. By imposing knowledge, academic success often hinges more on controlled, extrinsic motivation. In contrast, Self-Determination Theory recognizes more autonomous forms of extrinsic motivation, such as integrated regulation, where students not only recognize but also align the activity's value with their primary interests and values. The "Meaning of School" program could thus promote a more autonomous motivation, akin to intrinsic motivation, by assisting students in grasping the congruence between activities and their values.

The "Meaning of School" program provides students with insights into their cognitive functioning and encourages rethinking their perception of intelligence, presenting it as a developable capacity. Dweck's exploration of mindsets shows the distinction between fixed and malleable views of intelligence. A fixed mindset sees intelligence as unchangeable, interpreting failures as reflections of limited abilities [8,9]. Conversely, a malleable mindset views intelligence as adaptable, considering failures as learning opportunities [10]. These mindsets affect attitudes towards feedback and others' success: fixed mindset individuals may disregard constructive criticism and feel threatened by others' achievements, while those with a malleable mindset use feedback for improvement and draw inspiration from others' success [11]. Importantly, this malleable, or growth mindset, aligns with the basic psychological need for competence. This approach encourages children to see challenges and failures as learning and growth opportunities, thus enhancing their sense of mastery and competence. The Growth mindset concept is closely related to intrinsic motivation [12,13], considered independent but significantly influencing motivation [14–16]. Adopting a growth mindset and finding satisfaction in attending school can enhance student motivation, satisfaction and success [8,9].

This study aimed to evaluate the effectiveness of a program designed to improve students' well-being and academic persistence by improving students' motivation to attend school and increasing their satisfaction with the educational experience. The primary hypothesis was that program participants would develop a stronger growth mindset, greater satisfaction of basic psychological needs, and increased school motivation and satisfaction compared to non-participants. We measured the intervention's effects on satisfying fundamental psychological needs, school motivation, and satisfaction. Additionally, we specifically assessed the effects on the growth mindset, a key component targeted by this intervention.

Method

Design and settings

This research employed a controlled before-after design. The study was conducted in ten schools in the region surrounding Paris, including three schools from the Priority Education Network

(Réseau d'Education Prioritaire, REP), and six in an enhanced REP (REP+).

Sample

Initially, 22 classes were selected to participate in the research, and assigned to either the experimental condition or the wait-list control group who benefited from the program later during the same year. The selection of the classes was carried out by a third party external to the study (inspector of the National Education). The aim was to balance the distribution of classes between control and experimental groups to ensure that the comparison could be made between similar groups. Each student completed pre and post-intervention questionnaire with a specific code given by their teacher which enabled researchers to include students who had completed both pre and post-assessment with their code. One class was excluded from analyses due to non-compliance with this study protocol. Only the students with signed informed consent were included in the study. The initial sample was thus composed of 367 students aged 9 to 11 years, with 226 students in the experimental group and 141 in the control group (see Fig. 1). Among those, 56 were not present at the second measurement time-point or had missing data. Therefore, the final sample was composed of 311 students, with 174 students in the experimental group and 137 in the control group. Within the experimental group, two schools, comprising six classes, were randomly selected for a semi-structured interview averaging 28 min after the program. A total of 32 students were selected for individual interviews. The selection process was carried out by teachers from six REP+ classes. They chose 5 to 6 students per class, ensuring a diverse range of profiles while maintaining a balance in terms of gender, academic challenges, and behavioral issues at school. This methodology allowed for a comprehensive assessment of the intervention's impact, combining quantitative and qualitative data to provide a more nuanced understanding of the effects on student attitudes and behaviors.

Procedure

After obtaining consent from both parents and students, the questionnaires were completed individually and anonymously in the classroom. The experimental classes completed the questionnaire before and after participating in four sessions of the "Meaning of School" program, spread over a period of two months, with a 1.5-hour workshop every fortnight. Students in the control group did not follow any specific program during that period, but completed the questionnaires at similar intervals. Less than one month after the end of the program, a set of students participated in semi-structured interviews conducted by a researcher. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Materials

The Meaning of School program

The content of the program "Meaning of School" was developed and administered by a non-profit organization ("Le Sens de l'Ecole®") who proposes this program to schools that ask them to work on this aspect with 4th and 5th grade students. The program aims to raise students' awareness of the various aspects of their educational journey by showing the diversity of educational experiences worldwide, helping them realize that access to education is not easily available to everyone. It encourages them to acknowledge both the obstacles they face and the strengths they possess in their own educational pathways. A significant emphasis is placed on viewing mistakes as learning opportunities, prompting students to reflect on the various components of success (Table 1). Additionally, the program motivates

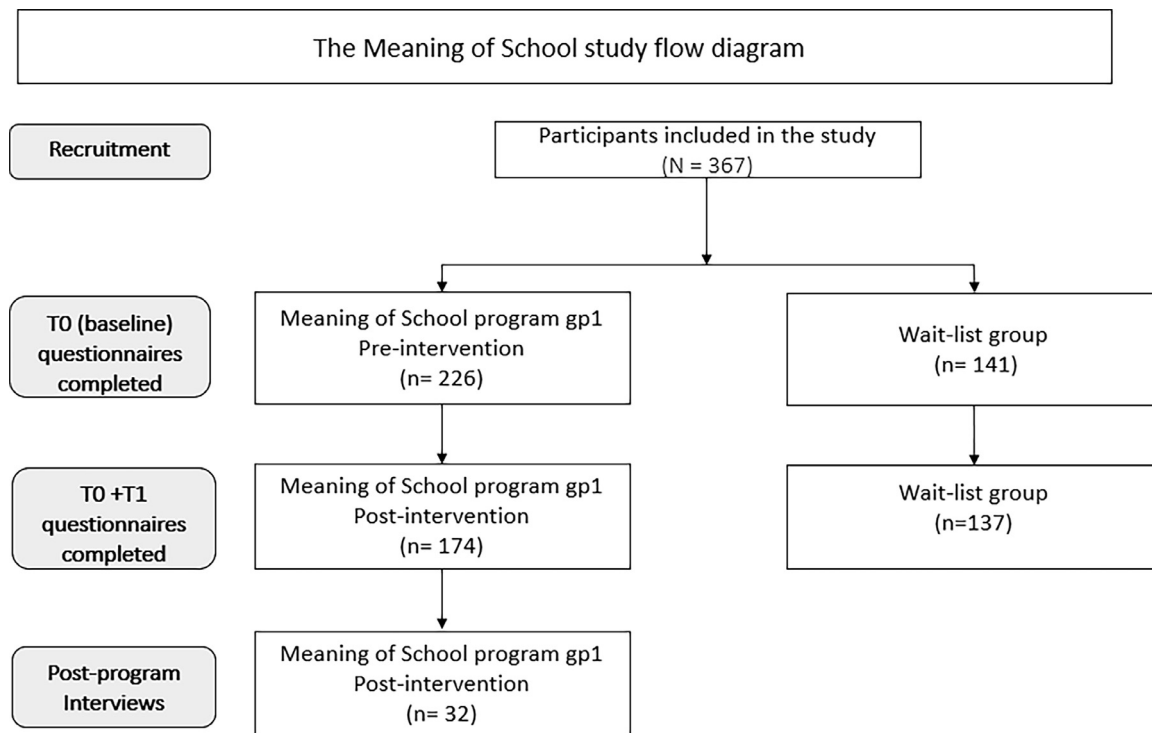


Fig. 1. The Meaning of School study flow diagram.

participants to contemplate the purpose of their schooling and to set a personal, inspiring educational goal. This goal is intended to be a concrete first step towards the person they aspire to become, thereby strengthening their commitment and motivation in their educational journey, and increase school satisfaction and well-being. The approach is based on collective and individual reflection, employing

active and cooperative methods. This also involves teachers in activities to ensure the effective and sustainable integration of educational objectives, such as fostering a growth mindset by, for example, encouraging the consideration of mistakes as learning opportunities in the classroom. Teachers can facilitate inter-session follow-up by providing reminders or delving deeper into a topic. A workbook is provided to each student to complete activities during sessions, between sessions, or to note personal reflections to share or keep private. For more details on the program’s content, see the supplementary materials.

Table 1 Summary of the program’s content and educational objectives.

	Activities	Educational Objectives
Workshop 1	Introduction Inner Weather Video Viewing The School Path My School Path Conclusion	Create a supportive workshop environment to encourage group reflection and individual expression, while highlighting that education is a journey with challenges that can be overcome.
Workshop 2	Reminder of the Framework Inner Weather and Ice Breaker Activity Recap of Workshop 1 Stories and reflections Photo-language Conclusion	Encourage students to contemplate the world’s major challenges and those that personally affect them, fostering a “purpose for learning” - the desire to excel in school to make a difference in the world one day.
Workshop 3	Introduction Inner Weather and Ice Breaker Activity Some Brilliant Mistakes They Didn’t Succeed on the First Try A Bit of Information About the Brain Conclusion	Encourage students to reflect on their attitudes towards mistakes and failure, and how they impact their perseverance and success, while teaching them about brain function and learning to promote a growth mindset.
Workshop 4	Introduction Inner Weather and Ice Breaker Activity My School Path (Continuation) My Next Small Steps at School Conclusion	Help students understand that education is the present means to become who they want to be and make a positive contribution to the world, while setting a personal, motivating learning goal as a concrete first step towards their ideal future.

Questionnaires

Self-report questionnaires measured the following variables rated on a five-point Likert scale ranging from (“I don’t agree at all” to “I totally agree”): (1) Growth Mindset (3-item growth mindset questionnaire; [17,18]) ($\alpha = 0.77$), (2) Basic Psychological Needs Satisfaction (BPNS; 13 items adapted from [19]) ($\alpha = 0.87$), (3) school motivation (4 items based on the Echelle de Motivation en Education; [20]) ($\alpha = 0.67$) and (4) school satisfaction (8-item subscale from the Multidimensional Students’ Life Satisfaction Scale; [21]) ($\alpha = 0.88$). Specific items were reverse-coded so that a higher score represents a stronger growth mindset, basic psychological needs satisfaction, school motivation and satisfaction.

A semi-structured interview guide was used to collect students’ responses. This questionnaire is divided into three main sections (see Supplemental Materials). The first section focuses on the description and reflection of the workshops, where students are invited to share their experiences, favorite activities, and the lessons learned from participating in the workshops. The second section involves a before-and-after comparison of the workshops, encouraging students to illustrate and discuss the perceived changes in their own behavior, as well as that of their peers and teachers, along with teaching methods. Finally, the third section concentrates on students’ personal perceptions, exploring their views on intelligence, their perception of mistakes, and their sense of belonging to school. This semi-structured interview guide aims to gain an in-depth understanding of the impact of the workshops on students in terms of growth, school

motivation, perception, and satisfaction, as well as positive classroom climate include social interaction quality.

Data analysis

Quantitative data analysis

Data were processed using the open-source software JASP 0.18.1 [22]. Before testing our hypotheses, we analyzed the continuity of variables in the questionnaires administered before (T0) and after (T1) the program. All the variables exhibited skewness [-0.89; -0.10] and kurtosis [-1.23; 0.59] indices within an acceptable range to conduct parametric tests, as these indices fell between -2 and +2 [16]. The only exception was the data related to BPNS at T0, which showed a skewness slightly outside this range (Skewness = 2.29, Kurtosis = -1.01).

To test our hypotheses, we conducted a series of repeated measures analysis of variance (ANOVA) with an error risk $\alpha = 0.05$ for each of our variables: Satisfaction, BPNS, Motivation, and Growth Mindset; before (T0) and after (T1) the intervention. A Welch's *t*-test, more robust to problems of variance homogeneity [23], was conducted on the difference between the mean at T0 and the mean at T1 for the variables with significant interaction effects between response times, comparing the experimental and control groups. Since our measures directly and indirectly focused on motivation and satisfaction (Growth Mindset and Basic Psychological Needs Satisfaction), we conducted an exploratory correlation analysis by adding into JASP software the average results obtained at T0 and T1 for each variable (see supplementary materials).

Qualitative data analysis

Thematic analysis was conducted using an Excel spreadsheet, where data from the semi-structured interviews were methodically organized and examined. Regarding the semi-structured interviews, they were transcribed by a researcher. Content analysis was performed using reflexive coding [23]. Each speech or comment was coded separately into meaningful categories that aligned with the research questions. These inductive nodes were then progressively refined and organized into coherent thematic categories. It is important to note that some children proposed several ideas, which did not always allow for precise numbering, particularly regarding the main motivations for going to school.

The complete dataset, encompassing both qualitative and quantitative data, is available on Mendeley Data along with the supplementary materials, see [24].

Results

Quantitative data

The repeated measures ANOVAs conducted on all our variables did not show any main effect or interaction effect, except for the growth mindset. There was a significant interaction effect between group and growth mindset [$F(1309) = 5.097, p = .025, \eta^2 = 0.016$]. The *t*-test confirmed that ($t = -2.341, df = 302.09, p = .020, Cohen's d = -0.26$) the experimental group had a greater growth mindset at T1 than at T0 ($Md = -0.22, SD = 1.51$), while the control group exhibited a lower level of growth mindset at T1 than at T0 ($Md = 0.14, SD = 1.22$) (Table 2). There were no significant main or interaction effects regarding school motivation [$F(1309) = 0.479$], satisfaction [$F(1309) = 0.895$], and BPNS [$F(1309) = 0.037$].

Regarding the Pearson's correlational analyses which aimed at checking the validity of the data collected regarding the usual correlations obtained among these variables, all our variables were found to be positively and significantly correlated with each other ($p < .001$) as shown in Table 3. A strong positive correlation was noted between students' Motivation and School satisfaction ($r = 0.71, 95\% \text{ CI } [.64, 0.79]$). Motivation also showed a moderate positive correlation with Growth mindset ($r = 0.32, 95\% \text{ CI } [.22, 0.44]$) and Basic Psychological Needs Satisfaction (BPNS; $r = .36, 95\% \text{ CI } [.21, 0.50]$). Similarly, School satisfaction was moderately correlated with BPNS ($r = 0.44, 95\% \text{ CI } [.29, 0.58]$) and weakly with Growth mindset ($r = 0.21, 95\% \text{ CI } [.09, 0.33]$). Finally, Growth mindset and BPNS showed a weak positive correlation ($r = .20, 95\% \text{ CI } [.05, 0.33]$). These results suggest significant links between the dimensions of Motivation, School satisfaction, Growth mindset, and BPNS.

Qualitative data

The analysis of the interviews showed that the workshops influenced participants' growth mindset, the meaning they attribute to school, and sense of belonging to school. Post-program, students perceived changes both collectively and individually. More precisely, 19 out of 32 (59.4 %) children mentioned a more respectful and peaceful classroom climate: "For example, in our class, nobody liked each other, they fought. There was nothing between them. And now, with the Meaning of School program, everyone likes each other, they play together, they talk, they help each other." About 25 % (8 out of 32) of students reported that fights had become less frequent: "Without the program, there are more who say bad words. There are those who hit, push, shove. And there are those who are mean. And with the program, there are those who don't push, who let others pass, who are kind, who don't shove". Additionally, 9.4 % (3 out of 32)

Table 2
Descriptive statistics and repeated measures ANOVA between groups over time.

Variable		n	Mean (SD)		Mean diff (T0 - T1)	F	p	η_p^2
			T0	T1				
Motivation	Experimental	183	3.712 (0.784)	3.649 (0.826)	.063	.479	.489	.000
	Control	128	3.523 (0.832)	3.521 (0.853)	.002			
	Md (Exp - Cont)		.189	.128				
Satisfaction	Experimental	183	4.018(0.706)	3.916 (0.796)	.102	.895	.345	.000
	Control	128	3.906 (0.836)	3.874 (0.883)	.032			
	Md (Exp - Cont)		.112	.042				
Growth mindset	Experimental	183	3.238 (1.240)	3.458 (1.285)	-0.22	5.097	.025	.016
	Control	128	3.402 (1.250)	3.259 (1.300)	.143			
	Md (Exp - Cont)		-0.164	.199				
Needs satisfaction	Experimental	183	3.85 (0.626)	3.839 (0.702)	.011	.037	.847	.000
	Control	128	3.895 (0.595)	3.871 (0.629)	.024			
	Md (Exp - Cont)		-0.044	-0.032				

Note. No missing value. Exp = Experimental; Cont = Control; Mean diff or Md = Mean difference.

Table 3
Pearson's correlations between main variables.

Variables	Motivation	Satisfaction	Growth mindset
Motivation	—		
School satisfaction	.714*	—	
Growth mindset	.325*	.207*	—
Basic psychological needs satisfaction	.359*	.444*	.201*

Note. Confidence intervals based on 1000 bootstrap replicates. * $p < .001$.

underlined greater cooperation: "I learned that it is good to help. That's what I learned the most", and 12.5 % (4 out of 32) expressed positive emotions in going to school: "Before, it was... I hesitated, but still, I always went. Now, I go with a lot of joy to school."

Concerning their satisfaction with basic psychological needs in school, 43.8 % (14 out of 32) found that the classroom atmosphere was calmer, with less chatter: "I have become calm, because before, I was a bit noisy". Around 28.1 % (9 out of 32) of students perceived increased perseverance and 15.6 % (5 out of 32) reported more confidence: "Yes, it has helped me regain confidence in myself. For example, like I said, if there's something I don't understand, if I can't do it, I don't want to give up anyway. So, I will always try again, and again, until it's right."

They also integrated the idea that intelligence can be developed, altering their relationship with mistakes and acknowledging them as part of the learning process. A significant portion, 68.8 % (22 out of 32), said that mistakes facilitate learning. Mistakes are described as an integral and normal part of the learning process: "If we don't make mistakes, we don't learn much either." Following the workshops, it appears that for them, learning occurs through making mistakes, and it's normal to err: "Everyone makes mistakes. Then, we can redo, start over, and it can work". Half of the participants (16 out of 32 or 50 %) expressed the idea of growth mindset in their own words: "For example, before, when I made a mistake, I wasn't happy. But now, when I make a mistake, I say it teaches me new things. So, we don't always succeed on the first try. And that's it."

Finally, the interviews highlight three main motivations for children to go to school. They report going to school to prepare for their future because school is there to learn in order to find a job – perhaps even a dream job – to have a good life: "What really happens at school. That school is something important. It's good to go to school. It's important. You have to work to succeed in life." School is also an important place for socialization, and they appreciate going there to meet their friends. Lastly, they go to school because it contributes to their personal growth: "School serves to build us. It helps us evolve. It helps us get stronger."

Discussion

The objective of this study was to measure the efficacy of a school-based intervention named "Meaning of School" (Le Sens de l'Ecole) aimed at fostering growth mindset, academic motivation, positive school perception and satisfaction by improving the meaning of school. Quantitative data analyses indicated that the intervention could improve students' growth mindset in predominantly Priority Education Networks (Réseau d'Éducation Prioritaire, REP). No significant effect of the intervention was found for school motivation, satisfaction and Basic Psychological Needs Satisfaction (BPNS). Qualitative data derived from semi-structured interviews, supported the findings regarding increased growth mindset, and also revealed additional beneficial effects on school motivation, satisfaction and well-being as well as improved classroom climate, including positive peer relationships. The results suggest that targeted interventions in schools can significantly influence the development of a growth mindset,

enhance motivation and classroom climate, and alter how students perceive their educational journey. These findings underscore the importance of pedagogical approaches that value mistakes as a key element of learning and promote a positive perspective on education. These initial results regarding this program are promising as each of these variables can contribute to students' academic perseverance [10,13,25]. The qualitative data provide insights into what a quantitative approach might reveal over a longer period, while offering detailed perspectives on the specific benefits of the program for the students. These data also allow students to reflect on and articulate their experiences within the program. Providing meaning to school is crucial not only for student engagement and well-being but also for their overall development, thus fostering a more enriching and sustainable educational experience.

In intervention research, demonstrating significant quantitative effects is rare [26], making the program particularly interesting to develop and evaluate further. Moreover, this highlights the importance of conducting mixed-methods studies to transcend the limitations of each approach, integrating both quantitative and qualitative perspectives for a more comprehensive understanding of educational intervention impacts. In our research, the qualitative approach is especially relevant as some students in our sample are non-native speakers and/or have literacy issues that hinder their written comprehension. Engaging with them during interviews ensured their understanding of the questions and a deeper comprehension of their perception of the workshop effects. The importance of continuing to refine and evaluate this type of intervention in REP in France is particularly relevant as studies suggest that this population tends to have a more fixed mindset compared to others [27,28], and the type of program proposed would be more beneficial for them [29]. The results of the study are in line with other studies that showed, among children of the same age, the importance of having a growth mindset to stimulate motivation and also to gain perseverance, interest or improved competence in certain subjects.

In our study, we observed significant and positive correlations between our measures. Notably, the strongest correlation existed between school motivation and satisfaction, aligning with Self-Determination Theory. This theory suggests that intrinsic motivation is driven by the enjoyment of spontaneous activity and curiosity [5,30]. It mirrors the fulfillment experienced in an activity. Other correlations showed that while the measured constructs were distinct, they were positively related to each other. Thus, these measures were appropriate to use in combination to observe the intervention's effect from various perspectives, maintaining relevance with existing literature [14,15,31,32].

Limitations and future directions

This study, while providing valuable insight into the efficacy of the 'Meaning of School' intervention, is not without limitations. First, given the controlled before-after design employed in this study, we cannot rule out the possibility that unidentified differences between the intervention and control groups may have influenced the changes observed in the outcome measures. Second, our reliance on self-reported data introduces the possibility of bias such as social desirability or response conformity. This possibility underscores the importance of a critical and nuanced analysis of the current data. Third, the study was conducted within a specific cultural and educational context (Priority Education Networks in the region surrounding Paris), which may not reflect the experiences of students in different settings. Finally, the short duration of the program and the timing of the post-intervention assessment may not fully capture the long-term impacts or the sustainability of the observed effects. These limitations underscore the inherent challenges and complexities specific to intervention research in France, reflecting current experience in managing these complexities while seeking to balance a rigorous

research design with the practical challenges of implementation [33,34].

Future research could address these limitations by employing a fully randomized design, incorporating a more diverse sample, and conducting longitudinal follow-ups to assess the lasting impact of the intervention. The observed effects could be even more powerful and beneficial over time. Indeed, the program aimed to include teachers, and it has been repeatedly shown that schools and teachers who value a growth mindset offer students opportunities to cultivate this mindset [35–37]. However, it should be noted that the impact of the program might be limited if teachers are not specifically trained to facilitate the sessions, they are only partly involved in facilitating the sessions. As highlighted by Durlak et al.'s meta-analysis on social and emotional learning programs, improvements in the quality of relationships are generally observed when the program is delivered by the teacher themselves, not by an external facilitator [38]. This suggests that to effectively influence the BPNS, it is crucial for teachers to be trained, involved, and to adopt a new posture or relationship with the students. Therefore, while the “Meaning in School” program has the potential to positively influence students, its impact on the BPNS might be limited without a corresponding change in the teachers' general pedagogical approach. Future studies replicating this study could thus benefit from additional training sessions and measures, such as including teachers' perspectives in the analysis and conducting surveys at multiple time points post-program, to assess its sustainable effects, including on student well-being and reduced school dropout.

Conclusion

This study evaluated a short intervention for 4th and 5th grade children in schools. While improvements could be made to the program, such as involving parents [39], evidence of its efficacy was demonstrated both quantitatively, through the increase of a growth mindset, and qualitatively. Thus, children benefiting from such an intervention are likely to foster academic perseverance and well-being by reducing risk factors such as relational problems at school or general discomfort [40].

Author contributions

CRediT taxonomy: Conceptualization, R.S., C.D. and Q.H.; methodology, R.S., C.D. and Q.H.; validation, R.S., C.D. and Q.H.; formal analysis, F.-X.C, Q.H. and C.D.; investigation, R.S., C.D. and Q.H.; data curation, Q.H. and F.-X.C; writing—original draft preparation, F.-X.C; writing—review and editing, F.-X.C, Q.H. and R.S.; supervision, R.S., C. D. and Q.H.; project administration, R.S., C.D. and Q.H.; All authors have read and agreed to the published version of the manuscript.

Declaration of competing interest

The authors declare no conflict of interest.

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Supplementary materials

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