



HAL
open science

Effects of daily creative writing practice at school on the cognitive development of children from disadvantaged socio-economic backgrounds

Cédric Hubert, Nathalie Bonnardel, Aline Frey

► To cite this version:

Cédric Hubert, Nathalie Bonnardel, Aline Frey. Effects of daily creative writing practice at school on the cognitive development of children from disadvantaged socio-economic backgrounds. *Thinking Skills and Creativity*, 2025, 58, <10.1016/j.tsc.2025.101881>. <hal-05094508>

HAL Id: hal-05094508

<https://hal.science/hal-05094508v1>

Submitted on 3 Jun 2025

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



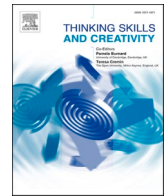
Copyright - All rights reserved



ELSEVIER

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Thinking Skills and Creativity

journal homepage: www.elsevier.com/locate/tsc

Effects of daily creative writing practice at school on the cognitive development of children from disadvantaged socio-economic backgrounds

Cédric Hubert^{a,b}, Nathalie Bonnardel^b, Aline Frey^{a,*}^a Aix-Marseille Université, CRPN - Centre de Recherche en Psychologie et Neurosciences, France^b Aix-Marseille Université, PSYCLÉ - Centre de Recherche en Psychologie de la Connaissance, du Langage et de l'Émotion, France

ARTICLE INFO

Keywords:

Creativity
Creative writing
Children
Learning
Longitudinal study

ABSTRACT

Creativity has become an essential skill in our complex, globalized and digital society. The question is whether it is possible to develop this skill at school. The aim of the present study was to analyze the effects of daily 20-minute creative writing workshops for primary school children, from low socio-economic backgrounds, on the development of their creative thinking skills and other more general skills. This longitudinal experiment involved a total of 161 participants in grades 2 to 5, who were assigned each year to either a creative writing group, a choral singing group, or a passive control group that did not participate in either workshop. Students were assessed at the beginning and end of each year on a range of creative, language and graphomotor skills, as well as on five personality traits. Results showed a significant advantage for the creative writing group in the development of verbal divergent thinking, imagination and emotional stability than the other groups, as well as an improvement in their verbal fluency. Spelling and graphomotor skills were not improved. These results highlight the fact that creativity may be a skill that can be trained at school, at least in a modality-specific way (in this case, verbal). Additionally, this improvement in creativity could transfer to other, more general skills. Overall, this study has the great advantage of showing, in the context of a longitudinal ecological study, the concrete benefits of training in creative writing, which seems promising for the future development of creativity at school.

1. Introduction

Our society has to satisfy a growing need for creativity and innovation, especially in order to face many current and future challenges, such as new ways of life and work that are necessary to face climate change, economical or epidemiologic crises, or even technological changes introduced by artificial intelligence (Anantrasirichai & Bull, 2022; Lopez-Bagousse et al., 2024; Mercier et al., 2021; Pellegrin et al., 2021). Therefore, creativity is identified as one of the essential skills of today's world to reach proposals or responses that are both new and adapted to our new societal contexts and challenges. Many global educational frameworks, such as the OECD (2019/2023), advocate for the development of skills to adapt to our changing environment, and creativity is especially required from future learners. Thus, it appears as an essential capability to be developed through creativity training programs in order to

* Corresponding author.

E-mail address: aline.frey@univ-amu.fr (A. Frey).

<https://doi.org/10.1016/j.tsc.2025.101881>

Received 5 October 2024; Received in revised form 6 May 2025; Accepted 26 May 2025

Available online 27 May 2025

1871-1871/© 2025 Published by Elsevier Ltd.

address such societal issues (e.g., Bonetto et al., 2024; Lucchiari et al., 2019; Ma, 2006; Ruiz-del-Pino et al., 2022). Nevertheless, despite the general consensus that there is a need for more creativity in the educational system (Glaveanu et al., 2013; Smith & Smith, 2010), favoring creativity in educational contexts and coming up with highly effective programs for the enhancement of creative expression continue to be a major challenge for educators (Beghetto, 2010; Bonnardel & Didier, 2016, 2020; Plucker, Beghetto & Dow, 2004; Plucker et al., 2011).

A first question is whether creative thinking is a trainable skill. Although it can be the object of debates, the quantitative review of Scott et al. (2004) concluded that “well-designed creativity training programs typically induce gains in performance with these effects generalizing across criteria, settings, and target populations”. However, developing creativity in the classroom seems particularly challenging for a variety of reasons, such as the convergence of teaching practices and teacher attitudes, as well as the difficulty of defining creativity (see Pichot et al., 2022; Weisberg et al., 2021) and assessing it (Cropley, 2000; Said-Metwaly et al., 2017).

Furthermore, if creative thinking can be trained and teachers are willing to develop it in their students, another question concerns the relationship between creativity and learning. In most educational contexts, learning is seen as distinct from the development of creative thinking. However, a point of view combining creativity and learning can be defended. For instance, Vygotsky (2004) described a ‘double, mutual dependence’ (p. 17) between the creative imagination and learning experiences (Beghetto, 2010). Therefore, one may question the extent to which creativity can be promoted in a school context and if developing creative skills on the part of learners helps them integrate better into the classroom and enhance their academic learning. Some studies showed that creativity has little or no correlation with academic achievement (e.g., Ai, 1999; Balgiu & Adir, 2014; Berlin, Tavani & Besançon, 2016). Overall, research findings show that correlation values between creativity and academic achievement are highly diverse, ranging from negative correlations (e.g., $r = -0.07$; Vijetha & Jangaiah, 2010) to strong positive correlations (e.g., $r = 0.66$; Tan et al., 2014). A meta-analysis performed by Gajda et al. (2017) concludes to a $r = 0.22$ correlation coefficient. These wide gaps could be explained by several challenges that creativity researchers have to face (Bonetto et al., 2024). As mentioned earlier, difficulties in comparing studies may be due to a lack of homogeneity in the measures used to assess the effects of the training provided. For example, in some studies, creativity is measured by creativity tests based on divergent thinking tasks (generating multiple solutions or ideas) only or on a combination of divergent and convergent thinking (narrowing options towards a single solution or idea) tasks (including verbal and/or figurative conditions), whereas in other studies it is based on self-report measures. Moreover, students’ creative thinking skills seem to be correlated with socioeconomic status (Castillo-Vergara et al., 2018), which could be explained by the fact that people with high socioeconomic status have more resources and learning opportunities. Complementary research suggests that the effect of creative thinking on academic performance depends on this socioeconomic status and gender, with a positive effect for boys and children from low socioeconomic backgrounds (Yang & Zhao, 2021).

In this paper, we consider that a main kind of creative thinking activity, which could potentially be proposed and developed in a school context is creative writing. Indeed, creative thinking and creative writing are intimately linked, with one nurturing the other in a dynamic process. Creative thinking can be described as based on an iterative process in which the individual elaborates, processes, tests, improves and modifies ideas through critical analysis and evaluation. This dynamic is described in certain models of creativity, such as the seminal model proposed by Wallas (1926). This author describes the creative process as based on four stages: (1) Preparation (which corresponds to gathering information and exploring the problem), (2) Incubation (which corresponds to unconscious period of reflection during which the brain works on the problem), (3) Illumination (which corresponds to the sudden appearance of an idea or solution, often referred as the “aha moment”), and finally (4) Verification (which corresponds to the evaluation and implementation of the idea and allows the individual to confirm its relevance).

A number of similarities can be pointed out between this model, for instance, and the one proposed by Hayes and Flowers (1980) for the writing process. This last model is structured into three main stages : (1) Planning, which corresponds to setting objectives, selecting ideas and organizing information, (2) Translation, which allows the writer to put his or her ideas into written form, and (3) Revision, which corresponds to the evaluation and improvement of the text produced, taking account of objectives and constraints.

Therefore, the models emphasize a step-by-step progression towards a final result. The preparation phase (Wallas, 1926) or planning phase (Hayes & Flower, 1980) shows that information gathering and pre-organization are essential to a productive process. These models also emphasize the importance of moments when ideas emerge as solutions and take concrete form, and they stress the importance of critical assessment (verification, evaluation, revision) to refine or adjust what is proposed until reaching the final product, be it an idea or a text.

In the educational context as, especially, at elementary school, where our research was conducted, the relationship between creative thinking and creative writing is particularly important, as these skills play a crucial role in children’s general development. Creative writing generally leads to the production of writings that goes outside the bounds of more formal writing, displaying imagination or invention (Morley, 2007). It can be an opportunity for pupils to express, in the school context, their feelings and thoughts. In addition, creative writing can be used to nurture the natural interest in writing and the inherent need for self-expression that many children experience when they start school (Essex, 1996). The integration of creative writing should encourage the development of creative thinking in young learners. Several kinds of benefits can be expected, such as the following:

1. Fostering imagination and divergent thinking

Creative writing encourages students to exploit their imagination, think divergently and generate original ideas. Through activities such as writing stories or, poems, students could learn to develop their creative thinking by approaching topics from different perspectives. For example, a question or task like “What would happen if animals could talk?” can elicit a variety of inventive responses. Indeed, according to Sternberg and Lubart (1999), children develop their creative thinking when they have to deal with open-ended tasks where several answers are possible.

2. Developing linguistic skills

In creative writing, students manipulate words and explore a variety of syntactic structures. This process contributes to the development of their vocabulary and possibly their understanding of language nuances. Creative thinking comes into play here to associate new ideas with words and phrases. For example, tasks such as writing an alternative ending to a classic short story would enable students to explore narrative structures while exercising their creativity. Thus, according to Britton (1970), creative writing would reinforce language skills while fostering a better articulation between personal expression and academic learning.

3. Strengthening motivation

Elementary school pupils would become more motivated when they can express themselves freely. Thus, creative writing would enable them to take their learning on as a matter of personal interest, and to relate it to their own world. This would strengthen their commitment to school activities.

4. Encouraging problem-solving

Creative thinking, in conjunction with writing, should help students solve narrative problems or invent original solutions in imaginary stories. This would enhance their ability to think critically and in new ways (see Guilford, 1967).

Thus, although the place of writing in school and everyday life is widely recognised, creative writing is rarely offered in most schools. The objective of this research is to analyze the extent to which creative writing practice at school contributes to the development of creativity, but also to more general cognitive skills. To this end, we conducted a longitudinal study over 3 years, in a school in a disadvantaged area of Marseilles (France), where a professional writer led daily creative writing workshops with the children. It's worth noting that daily interventions are rare and valuable, given the importance of repetition in learning (Dahlin & Watkins, 2000). We tested these children on a range of cognitive and social skills, and compared their performance with children who practiced a daily singing activity (active control group) and with children not practicing either of these two activities (passive control group). Initial results from the first year of the project alone (Gutiérrez Cisneros et al., 2023) have already revealed benefits for children from creative writing groups in their reading skills, as well as in the development of their vocabulary and fluency. In this article, we present the results including longitudinal monitoring of the children's performance over 3 years and looking more specifically at their creative thinking skills as well as other cognitive indicators.

A general hypothesis was that practicing creative writing should contribute to the development of creativity. Creative writing workshops should train both divergent thinking abilities (to generate new ideas) and convergent thinking abilities (to respect the instructions of the workshop). In addition, we also expected to observe greater growth in writing skills and verbal fluency in children practicing creative writing than in those who do not. Finally, this activity could also influence certain personality traits, leading children to be more imaginative and extroverted.

2. Material and methods

2.1. Participants

The study was conducted using a longitudinal paradigm during three years. The sample was composed of a total of 161 children (81 girls, 80 boys) over the three years, from a primary school (which had the advantage of limiting possible variations in the children's socio-economic background). Participants distribution included pupils from second grade to fifth grade. 80 children were assessed the first year, 113 the second year (72 new ones), and 57 the third year (9 new ones). Details on the number of participants per grade and year are available in Table A1 in the Appendix.

A power analysis for linear mixed models (Kumle et al., 2021) estimated a statistical power of 53.4 % (95 % CA: [50.25 %, 56.53 %]) given our sample size, which is reasonable for field research.

All participants had normal or corrected vision and normal hearing. Finally, according to the socioeconomic indicator used by the French ministry of national education (Rocher, 2016), this school is below average, with an IPS score that falls within the 90–95 range.

This study was conducted in agreement with guidelines for the protection of human participants as defined in the declaration of Helsinki and was approved by the local ethics committee of Aix-Marseille University (N/Ref: 2022-11-24-006). All parents were asked to give their informed written consent for their children to participate in the study. Individual testing sessions took place in a calm classroom at school. The procedure was carefully explained to the children, to ensure that they agreed to participate. They were informed that they had the option to discontinue their participation at any point.

2.2. Procedure

The study took place over three years (from September 2020 to May 2023). Each year, for the different school levels involved, we carried out a class-randomization, i.e., each class was arbitrarily assigned to a group: either carrying out a daily creative writing activity, or a daily choral singing activity, or not taking part in a specific activity and carrying out normal class work with their teacher. This approach has been shown to circumvent the potential for a motivation bias to occur, that would arise when students are permitted to select their own activity. What is more, it is indeed classically recognized that people tend to behave differently when they know they are being studied (e.g., Hawthorn effect). More particularly in the classroom, production could be increased just by "doing something - in fact anything" (Gardiner, 1980, p. 303). Novelty and being observed can generate motivational effects and improve, at least temporarily, performance (Chiesa & Hobbs, 2008). This is why we compared the performance of the group practicing creative writing with that of another group, which carried out another activity, here singing, just as motivating and stimulating, at the same pace.

Furthermore, as this was a field study in consultation with the teachers, we had to take into account a number of constraints. In

particular, the teachers could not strictly maintain the same composition of classes from one year to the next (e.g. to separate 2 disruptive pupils). As a result, some children did not all attend the same workshops over the 3 years. To account for this bias, we decided to use mixed models, which allow us to consider children's progress year by year, according to the type of workshop, regardless of what they did in the previous year.

The activities took place every school day (Monday, Tuesday, Thursday and Friday), during twenty minutes, all year long. In the two workshops, as in the passive control group without workshops, the teacher remained in the classroom to ensure that things went smoothly and that children remained engaged in the activity.

The creative writing activity was directed by an external specialist in creative writing belonging to a literacy association called "La Marelle"¹. The goal was for each child to write small original stories on a given topic, to train their imagination and creativity. Each topic was studied over a period of one week, resulting in four 20-minute sessions. The initial session was devoted to the introduction of the subject matter, followed by a collective discussion between the children and the speaker on the various aspects that could be addressed by this thematic. These exchanges enabled each participant to comprehend and contemplate the writing possibilities of the topic, sharing their ideas with others. For instance, the topics could have been "what if objects could talk" or "writing about a good memory". Some vocabulary related to the theme could be introduced. In the second session, the speaker presented a text example on the topic to the participants, after which each participant started the writing of their own individual text. In the third session, participants were instructed to continue their written work. With some topics, an additional constraint could be given to them (example : writing in the form of a poem, or condensing the text to focus exclusively on the most salient elements), requiring pupils to engage in both divergent and convergent thinking processes, and therefore making these workshops a training for creative thinking overall. The fourth and final session entailed the reading of the produced texts by volunteer participants, with comments provided by the listening participants. This methodology should engender an increased awareness among pupils of the impact of "their own and others' decision-making on written work, and of the writing process as situated within an interactive, dynamic classroom where students share informed criticism" (Leahy et al., 2014).

The choral singing activity was directed by an external musician belonging to a local choir called Musicatreize.² It included vocal warm-up exercises, then the singing of memorized songs. On an annual basis, a selection of songs were taught to the pupils. This learning, similarly to the creative writing workshops, followed a weekly structure (four 20 min sessions). The first session of each week was dedicated to the review of material covered in the previous week. Then, the second and third sessions introduced new elements. It could be a new verse, or the chorus of the song. The fourth session consisted in a review of all the songs that had been learned up to that point during the current year.

Several cognitive tests were administered at the start and the end of each academic year: pre-tests between mid-September and mid-October, and post-tests in May. The tests were conducted by 5th year speech therapist students. These students were already familiar with the administration and scoring of these tests. We made sure beforehand that they had a good command of their passation, and that the conditions were exactly the same for all the children, regardless of the experimenter.

2.3. Measures

2.3.1. EPoC

Creative thinking capacities, more specifically the divergent-exploratory and convergent-integrative thinking processes, were assessed using the entire EPoC (Evaluation of Creative Potential) battery (Lubart et al., 2011). This battery consists of four subtests measuring verbal divergent thinking, verbal convergent thinking, graphic divergent thinking, and graphic convergent thinking. In the verbal divergent thinking task, the participant had to create as many endings as possible from a story beginning. In the verbal convergent thinking task, the participant had to create one story starting from a given title. In the graphic divergent thinking task, the participant had to create as many drawings as possible from an abstract graphic shape. In the graphic convergent thinking task, the participant had to create one drawing using several elements from eight graphics shapes stimuli. The EPoC battery has been used in several research projects (Valois et al., 2020) and the authors of the manual have confirmed their model through confirmatory factor analysis. Pre-tests were conducted using Form A of the test, and post-tests using Form B, to avoid a repetition effect.

These 4 tasks were graded according to the recommendations in the EPoC grading manual by a panel of 3 people among the experimenters. The final score for each of these subtests is the average of the marks, including production quality and quantity criteria. The Intraclass Correlation Coefficient (ICC) was calculated to estimate the inter-rater agreement, following the guidelines of Koo and Li (2016). This resulted in the selection of a one-way random effects, absolute agreement, multiple raters ICC.

2.3.2. BHK

Writing ability was assessed using the BHK writing test (Charles et al., 2004). Participants were asked to copy a short text, with the specific instruction to go at their usual speed. The text produced was evaluated qualitatively using morphokinetic and topokinetic criteria, and writing speed was assessed by the number of characters written. The authors

2.3.3. ODEDYS dictation

A dictation subtest from the ODEDYS battery (Jacquier-Roux et al., 2005) was administered to assess the ability to associate

¹ <https://www.la-marelle.org/>

² <https://www.musicatreize.org/>

graphemes with phonemes. Three lists of ten regular words, irregular words and pseudo-words were used and read to each participant. Correctly written words were counted, pseudo-words were judged as correct if the written grapheme could match with the phonemes.

2.3.4. Verbal fluency

We also evaluated verbal fluency by asking the participant to list as many words as possible respecting a specific criterion, with a one minute time limit (Cardebat et al., 1990). The criterion could be words starting with a given letter, or belonging to a given category (animals, fruits).

2.3.5. Similarities

For verbal reasoning and concept formation, we used the Similarities test (WISC-V - Wechsler, 2016). Two words are presented to the participant, he/she has to identify a link between them (Example : How are butterflies and bees similar? 0 point: They live outside; 1 point : They are animals; 2 points: They are insects).

2.3.6. HiPIC personality questionnaire

The Hierarchical Personality Inventory for Children (HiPIC, Mervielde and De Fruyt, 1999), a personality questionnaire inspired by the Big Five model of personality, was also used. Rossier et al. (2007) validated a French version of the questionnaire, and also developed a version that is answered directly by the child rather than by the parents (Quartier & Rossier, 2008), which is the one we used in this study. It quantifies personality through five traits: emotional stability, extraversion, imagination, benevolence and conscientiousness.

2.4. Data processing

Data were analyzed using Linear Mixed Models (LMM). The objective was to compare the different groups progression during a year to identify the effects of the activities. A model was defined for every test dataset. For this purpose, the activity practiced throughout the year was used as a fixed effect, defined by the group of the individual. The temporality (pre/post) of the tests was also used as a fixed effect, along the interaction between group and temporality. This last one is what we used to compare the group progressions. The group and pre-post fixed effects variables were dummy coded, with “control” and “pre” as the reference levels. The initial random effects structure of every model consisted in random intercept and slopes for participant, grade and the interaction between the two.

We used R and the “lme4” package (Bates et al., 2015) to define the mixed models. Convergence of the different models was assured by the “allFit” function from the “afex” package (Singman et al., 2016).

We followed the procedure described by Brown (2021) to determine the final random effects structure of every model, resulting for most of them in only keeping the random intercepts. If not redefined in the model section, the random effect structure used for the models presented in the results is random intercepts for individuals, grade and the interaction of individual and grade. The interaction of individual and grade random effect is the most important one, enabling us to compare the pre and post results of a given individual for a given school year. When the random effects structure had to be restricted, we kept at least this random effect, so the model would stay meaningful.

The full model equation with fixed and random effects for a given dependent variable is :

Dependant variable ~ *group*temporality* + (1 | *indiv.*) + (1 | *grade*) + (1 | *indiv. : grade*)

We also followed the procedure to evaluate the significance of the fixed effects, by comparing each model with a “reduced” model without the group and temporality interaction fixed effect, by conducting likelihood-ratio tests. This allows us to estimate if the effect removed in the reduced model had an impact on the fitness of the model to the data, e.g. did the practice of the activity had an impact on the progression of the participants in the modeled test? The next step was to evaluate the significance of the fixed effects estimates, we did it by applying the “t as z” approach (Luke, 2017). Reduced models were also used to evaluate temporality (pre-post) main effect.

The assumptions of the linear mixed models were checked using graphical representations and heuristic methods. It is worth noting that assessments of normality, such as the Shapiro–Wilk test, or homoscedasticity, including the Levene test, can become overly stringent when applied to large samples. Consequently, the methodology outlined by Kim (2013) was employed to verify the normality of the residuals of the models, using skewness and kurtosis as metrics. For samples exceeding 300 individuals, normality could be rejected if the skewness exceeded 2 or the kurtosis exceeded 7. Similarly, the homoscedasticity of the data for each model was verified by dividing the residual values into four equal groups (based on the fitted values quartiles) and calculating the ratio of the maximum variance to the minimum, as recommended by Tabachnick et al. (2013), with the expectation that this ratio would be 3:1. In cases where the data were deemed not to meet the underlying assumptions, a square root transformation was performed on the dependent variable predicted by the model to ensure compliance with these assumptions.

3. Results

3.1. Overview of pre-post progression

The means obtained for each test by group and year are available in Table A2. Two models, the irregular words dictation and the EPoC verbal convergent thinking test, didn’t satisfy the assumption of homoscedasticity (See Table A3). To correct this, a square root transformation was applied to the dependent variable of these two models. For the EPoC test, the Intraclass Correlation Coefficient was

calculated, and as it is above 0.90, it can be considered as excellent reliability according to Koo and Li guidelines (2016) (ICC= 0.94, 95 % confidence interval: [.93, 0.94], $F= 15.75$).

Results from the reduced models suggest, unsurprisingly, that there is a significant progression between pre and post in the BHK writing test ($\beta= -2.64$, $SE= 0.54$, $t= -4.86$), the dictation test ($\beta= 1.50$, $SE= 0.31$, $t= 4.92$), the lexical ($\beta= 1.85$, $SE= 0.30$, $t= 6.09$) and semantic ($\beta= 2.41$, $SE= 0.34$, $t= 7.18$) verbal fluency tests. Significant progressions were also observable in the reduced models of the similarities test ($\beta= 4.54$, $SE= 0.33$, $t= 13.65$), EPoC verbal divergent thinking ($\beta= 0.55$, $SE= 0.11$, $t= 5.05$), and graphic divergent thinking ($\beta= 0.27$, $SE= 0.09$, $t= 2.98$) tests. This is also true for the extraversion category of the HiPIC questionnaire ($\beta= 1.10$, $SE= 0.38$, $t= 2.91$).

However, there seems to be no pre-post main effect in the EPoC graphic convergent thinking test ($\beta= 0.01$, $SE= 0.12$, $t= 0.09$), the verbal convergent thinking ($\beta= 0.13$, $SE= 0.08$, $t= 1.62$), and the benevolence ($\beta= -0.39$, $SE= 0.52$, $t= -0.74$), conscientiousness ($\beta= -0.08$, $SE= 0.45$, $t= -0.18$), emotional stability ($\beta= -0.18$, $SE= 0.35$, $t= -0.52$) and imagination ($\beta= -0.26$, $SE= 0.36$, $t= -0.72$) categories of the HiPIC questionnaire.

3.2. Group comparisons

For each dependent variable, a likelihood-ratio test was used to compare the fit of the reduced model to the one of the full model. For several tests, the full model failed to be a better fit : EPoC verbal convergent thinking ($\chi^2(2)= 0.15$, $p= .93$), graphic convergent thinking ($\chi^2(2)= 0.28$, $p= .87$) and graphic divergent thinking test ($\chi^2(2)= 3.99$, $p= .17$), HiPIC benevolence trait ($\chi^2(2)= 0.17$, $p= .92$), conscientiousness trait ($\chi^2(2)= 0.04$, $p= .98$) and extraversion trait ($\chi^2(2)= 2.65$, $p= .27$), similarities test ($\chi^2(2)= 1.62$, $p= .45$), and semantic verbal fluency ($\chi^2(2)= 1.37$, $p= .50$).

The next sections will detail, when the full model presented a better fit than the reduced model or the likelihood-ratio test was indecisive, the effects of the activities practiced on the progression in each test (group : temporality interaction effect).

For the verbal divergent thinking subtest, the likelihood-ratio test seems to indicate that the model with the group : temporality interaction fixed effect was a better fit for the data than the model without it ($\chi^2(2)= 9.88$, $p= .007$).

The creative writing group displays a greater progression than the two other groups : -0.05 for the control group, +0.47 for the singing group, +0.91 for the writing group. The difference is only significant versus the passive control group ($\beta= 0.95$, $SE= 0.31$, $t= 3.11$) (See Table 1 and Fig. 1).

We analyzed the full model for two of the HiPIC traits for the emotional stability trait. It was difficult to distinguish the better model between the full and the reduced models ($\chi^2(2)= 4.56$, $p= .10$). The reduced model fails to show a pre-post significant effect ($\beta= -0.18$, $SE= 0.35$, $t= -0.52$). However, the analysis of the full model points to a score increase for the creative writing group (+0.76), and a decrease for the choral singing group (-0.84) and the control group (-0.55) (see Fig. 2). The difference is only significant in the writing versus singing comparison ($\beta= 1.61$, $SE= 0.77$, $t= 2.09$).

At last, the random effects structure for the imagination trait model had to be reduced to "(1 | indiv. : grade)" to prevent singular fit issues. The likelihood-ratio test seems to indicate that the full model is a better fit than the reduced model ($\chi^2(2)= 5.77$, $p= .06$). Once again, we observe in the full model a score increase for the creative writing group (+0.78), and a decrease for the choral singing group (-1.10) and the control group (-0.38) (see Fig. 3). The difference is only significant in the writing versus singing comparison ($\beta= 1.88$, $SE= 0.78$, $t= 2.42$).

Handwriting quality was evaluated through the BHK test. The BHK score is a degradation score : a high handwriting quality will result in a low score, and vice versa. The likelihood-ratio test between the full model and the reduced model can hardly distinguish the full model as a better fit ($\chi^2(2)= 3.82$, $p= .15$). The reduced model indicates an expected progression ($\beta= -2.64$, $SE= 0.54$, $t= -4.86$). In the full model, the choral singing group seems to have progressed more (-3.69) than the creative writing group (-2.34) and the control group (-0.84). Those differences are almost significant in the singing versus control comparison ($\beta= -2.85$, $SE= 1.49$, $t= -1.91$).

For the dictation test, we first considered the total score sum of the three subtests. The likelihood-ratio test indicates that the model with the group : temporality interaction fixed effect was a better fit for the data than the model without it ($\chi^2(2)= 5.99$, $p= .05$). The full model reveals that the progression was greater for the control group (+2.82) than for the writing group (+1.64) and the singing group (+0.7939). This difference is significant for the control vs singing comparison ($\beta= -2.03$, $SE= 0.83$, $t= -2.44$).

Afterwards, we tried to model each of the three subtests results separately. The group : temporality interaction fixed effect seems to not affect the irregular words subtest ($\chi^2(2)= 0.07$, $p= .96$), somewhat affect the regular words subtest ($\chi^2(2)= 5.38$, $p= .07$), and more probably affect the pseudo-words subtest ($\chi^2(2)= 5.38$, $p= .009$). The full models for the regular words and pseudo-words results are coherent with the model for the score sum. The control group is the one which progresses the most, followed by the writing group

Table 1
Verbal divergent thinking LMM fixed effects.

	Estimated β	Std. Error	t-value
Intercept	3.43	0.28	12.03
Singing group	-0.86	0.24	-3.59
Writing group	-0.75	0.24	-3.12
Post	-0.05	0.25	-0.18
Singing:Post	0.52	0.31	1.72
Writing:Post	0.95	0.31	3.11

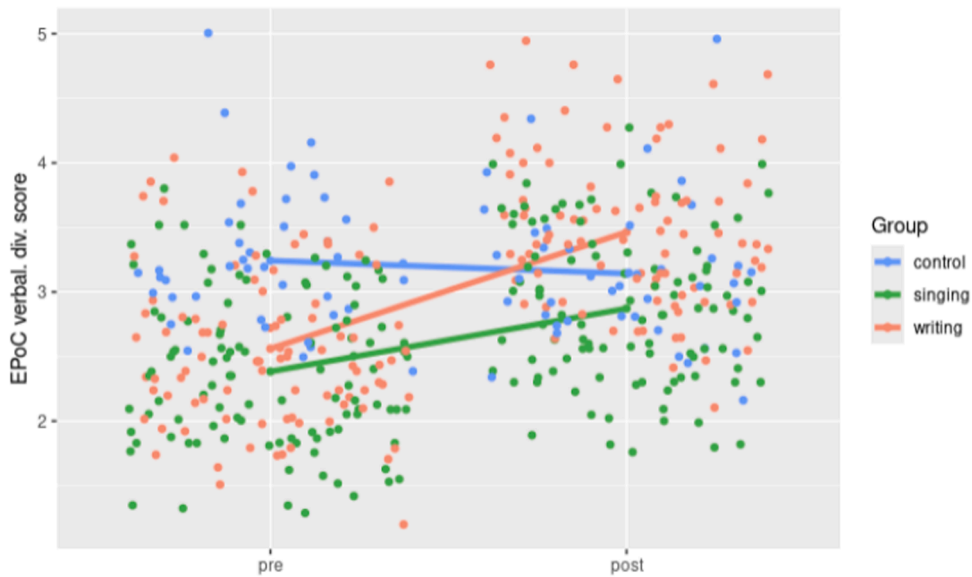


Fig. 1. Predicted values by LMM of the evolution of EPOC verbal divergent subtest score between pre and post tests by group.

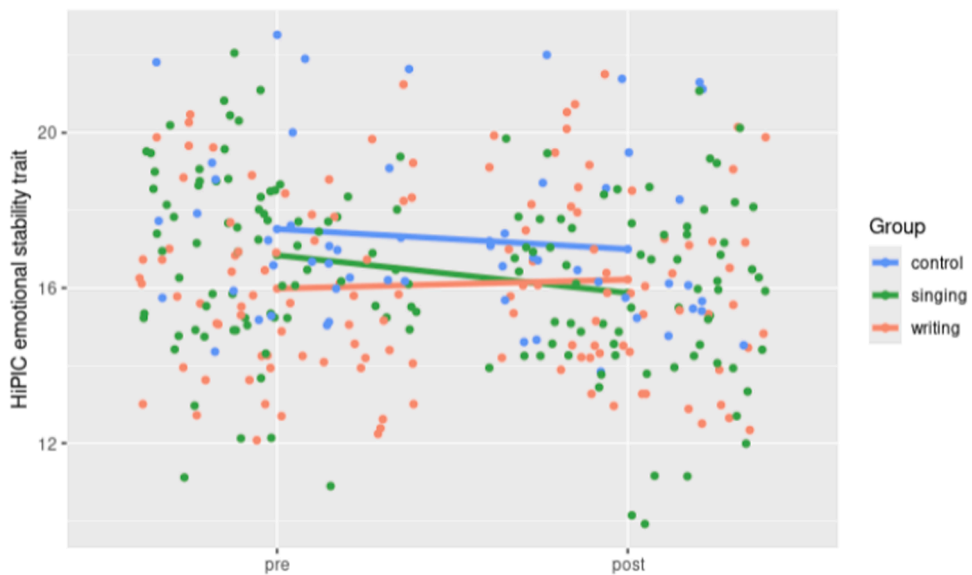


Fig. 2. Predicted values by LMM of the evolution of HiPIC emotional stability score between pre and post tests by group.

then the singing group (see Tables 2 and 3).

For the verbal fluency lexical subtest, the likelihood-ratio test gives a slight, non significant, lead to the full model ($\chi^2(2) = 3.92, p = .14$). In the full model, the creative writing group has a greater progression than the others : + 2.63 points for the writing group, + 1.49 for the control group, and + 1.29 for the singing group (see Fig. 4). The only significant difference is in the writing vs singing comparison ($\beta = 1.34, SE = 0.67, t = 2.00$).

4. Discussion

In this study, we sought to investigate the effects of introducing daily 20-minute creative writing workshops into an elementary school curriculum. To do this, we conducted a longitudinal study over three years, comparing the performance of children who participated in the creative writing activity with that of children who participated in a daily choral singing activity (active control group) or with other children who participated in standard school learning (passive control group). We assessed a total of 161 students over three years, in grades 2, 3, 4 or 5, who were tested at the beginning (pre-test) and end (post-test) of each school year. The data

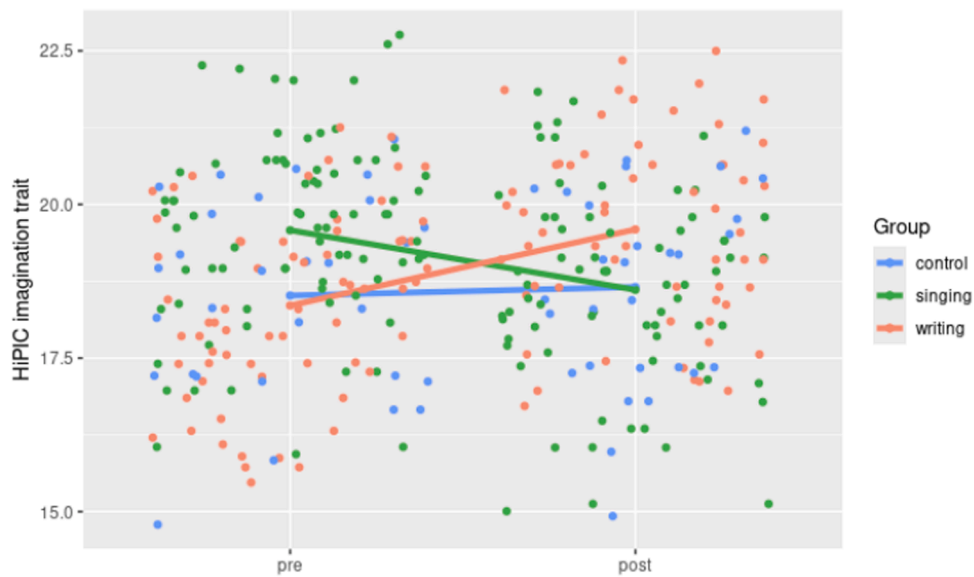


Fig. 3. Predicted values by LMM of the evolution of HiPIC imagination score between pre and post tests by group.

Table 2

Dictation regular words subtest LMM fixed effects.

	Estimated β	Std. Error	t-value
Intercept	3.91	0.88	4.46
Singing group	0.55	0.34	1.63
Writing group	0.74	0.33	2.27
Post	1.44	0.30	4.88
Singing:Post	-0.82	0.36	-2.30
Writing:Post	-0.67	0.36	-1.85

Table 3

Dictation pseudo-words subtest LMM fixed effects.

	Estimated β	Std. Error	t-value
Intercept	4.05	0.95	4.28
Singing group	0.32	0.35	0.92
Writing group	0.33	0.34	0.96
Post	1.44	0.32	4.55
Singing:Post	-1.18	0.38	-3.09
Writing:Post	-0.77	0.39	-1.97

collected concerned creative thinking skills, personality traits, handwriting, dictation, verbal reasoning and verbal fluency skills, and were processed with Linear Mixed Models (LMM) across the 3 years.

The results show, first of all, a main effect of the temporality of the tests (pre vs. post-test) for the majority of the tests, as expected since the children develop and follow school learning between the beginning and the end of the year. However, this progression was not significant for certain creativity subtests (both convergent thinking tests) and for certain personality traits (benevolence, conscientiousness, emotional stability and imagination). This absence of main effect is mainly explained by an interaction effect with the groups, which smooths the main effect (cf. below).

Furthermore, in line with our hypotheses, our results show an interaction effect between temporality and group in the divergent verbal EPOC task, with a greater progression between pre and post for the children in the creative writing group. As a reminder, in this subtest, the students had to create several endings to a given story beginning, which is quite similar to what they did in the workshops. This finding is consistent with those of other researchers who have explored the potential of creative writing workshops in schools and observed progress in creative thinking (Marcos et al., 2020), and more specifically showing that divergent thinking ability was significantly related to creativity in storytelling (Hoffmann & Russ, 2012). Creative writing, as opposed to more formal writing, would therefore encourage students to broaden their sources of inspiration, play with verbal materials and be open to new ideas. Like other creative activities, creative writing requires interaction and cyclical movement between phases of generating new ideas and new narratives, but also phases of evaluating, organizing, editing and refining (e.g., Bonnardel, 2009, 2012). Thus, a first, intuitive and

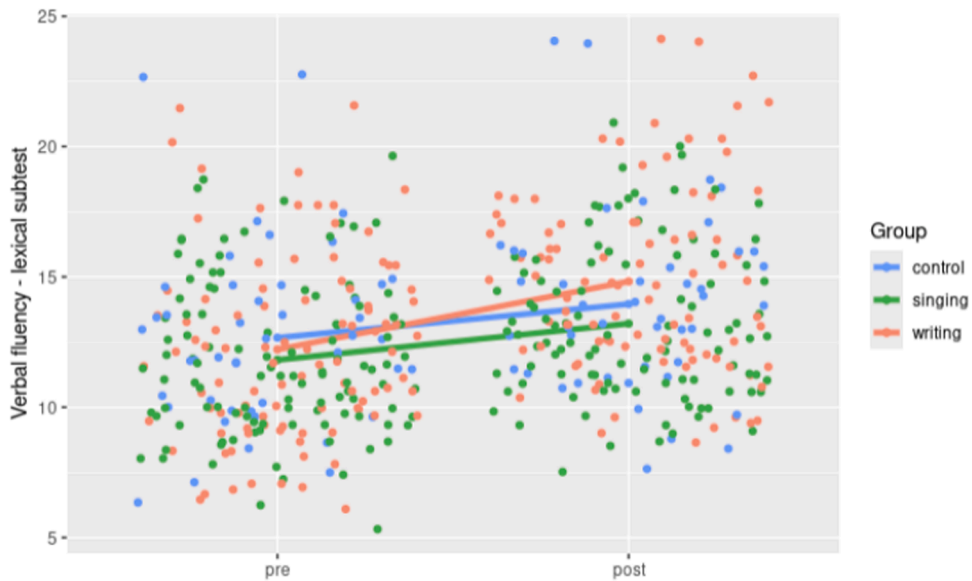


Fig. 4. Predicted values by LMM of the evolution of HiPIC imagination score between pre and post tests by group.

spontaneous system of thinking and a second, more deliberate and analytical one would contribute to the different stages of the writing process. In the first stages of creative writing, the first system is mainly used, allowing students to generate ideas and verbal proposals without significant restrictions. This stage would be mainly associated with divergent thinking, leading to the creation of unexpected and novel plots. The second system would then become more dominant and would be particularly mobilized to analyze the coherence of the story and to refine the language. It would therefore play a crucial role in evaluating the story and deciding which elements to keep or discard, in line with convergent thinking.

However, despite an increase in verbal divergent thinking ability, we did not observe a greater increase for the creative writing group in the verbal convergent thinking task. Convergent thinking has been defined as 'the ability to focus on an idea, a response that best fits the constraints of a task', but also 'bringing multiple elements together through synthesis and integration to create novelty' (de Vries & Lubart, 2019). The creative writing workshops in our study had themes and constraints to adhere to and, in this sense, required a convergent thinking approach. The lack of advantage for the creative writing group in the convergent thinking task could be explained by the fact that standard school activities also rely on convergent thinking processes, through the application of specific instructions and rules. As a result, the creative writing workshops did not lead to a greater gain in convergent thinking without a reduction in performance. The generation of new and original ideas may have been particularly valued in the creative writing workshops offered to the students, which would explain the higher scores in the verbal divergent task than in the verbal convergent task. There might have been a risk that encouraging divergent thinking would be to the detriment of convergent thinking. In this respect, these workshops made it possible to train divergent thinking skills without restricting the development of convergent thinking skills.

Finally, the progression in divergent thinking only applies to the verbal task and not to the graphic task. This result must be questioned in light of the controversy over whether creativity is domain general or domain specific (Plucker, 2004; Silvia et al., 2009). Baer (2012; 2015) pointed out that a creativity training programme must either focus on a specific domain or include tasks in a variety of domains, if the aim is to achieve a more general development of creative thinking skills. This may explain why, in our results, the creative writing group had an advantage only in the verbal divergent thinking task, and not in the graphic task.

The results also showed an interaction between temporality and group, in favor of the writing group, showing stronger traits of emotional stability and imagination after the workshops. It seems therefore that the workshops enabled the students to develop their ability to manage their emotions and cope with negative ones. This is consistent with the idea, already supported in the literature, that creativity skills promote optimal emotion regulation (Sundquist & Lubart, 2022). This finding is important to highlight, as emotional stability is expected to facilitate learning at school (Scoffham & Barnes, 2011), and more generally it is a trait that is considered to play an important role in an individual's happiness (Hills & Argyle, 2001). Concerning imagination, our results show that this trait decreases in the singing group and in the control group, while performances are maintained in the writing group. These results are in line with the literature showing that imagination declines steadily between ages 8 and 12 (Rossi et al., 2007). Our research shows in an interesting way that creative writing workshops make it possible to keep imagination stable across development.

In terms of writing skills, measured by the BHK and the word dictation tests, our results show no significant effect in favor of the children who took part in the creative writing workshops. On the contrary, on the word dictation test, the control group made better progress than the writing group, both for regular words and for pseudowords. For irregular words, all three groups showed a lack of progress, which undoubtedly indicates the difficulty of the task for these pupils, who come from disadvantaged neighborhoods and for whom spelling skills are unlikely to be acquired at this age.

As we pointed out above, the creative writing workshops were not focused on form but on content, on the generation of ideas and discussion of the texts produced. The external intervener did not give any feedback on spelling. It could therefore be that during this time the children in the control group worked more on developing their graphic and spelling skills, which are a large part of the school curriculum. Furthermore, for the BHK, it was the singing group that showed a significant improvement in performance. This result was unexpected, as the other two groups (writing and control) actually wrote more than the singing group. However, more and more studies are highlighting the link between handwriting and rhythmic skills. The results of correlational, behavioral and neuroimaging studies suggest a relationship between motor and rhythmic skills (Grahn & Brett, 2007; Monier & Droit-Volet, 2019; Whittall et al., 2008, as cited in Lê et al., 2020). In contrast, Frey et al. (2022) failed to improve grapho-motor skills through rhythmic training in kindergarten children.

In the fluency tests, the creative writing group improved marginally more than the other groups, but only in the lexical subtest and not in the semantic subtest. The verbal fluency task we used, requiring the participant to say as many words as possible within a constraint, appears to rely on both divergent and convergent thinking. Therefore, it makes sense that we would see a simultaneous progression for the creative writing group with respect to both divergent thinking skills and verbal fluency. This is in agreement with studies showing links between creativity and verbal fluency (Silvia et al., 2013).

Our research has therefore produced several important results. On the one hand, it allows us to show that creativity is a skill that can be worked on and improved at school, even if the improvement seems to remain specific to the learning modality, in our case, verbal. Furthermore, our results also show learning transfers from this verbal creative potential to other personality traits, such as imagination and emotional stability, which normally tend to decline during schooling. These skills are important for learning, but also for the well-being of children as future citizens. A limitation of our study is that, as an ecological protocol, the distribution of students was not fixed from one year to the next, and the effects could have been maximized if the children in each group had remained the same over the three years. Furthermore, this meant that sometimes the initial level of students was not the same in each group, and although the use of mixed models allows for this to be taken into account, it may still have resulted in lower progress for groups with a higher initial level, and vice versa. However, our study suggests that the use of creative writing workshops in primary schools could benefit students in several ways.

As previously emphasized, writing is widely regarded as the most significant indicator of success in literacy education. It is a key component of assessment across all education systems and serves as both a measure of competence and a vital tool for effective workplace communication. Strong writing skills are crucial for civic engagement, allowing individuals to express their views clearly in political, social, and business contexts. With the rapid rise of technological communication, the ability to write effectively for various purposes has become increasingly important (Graham, Harris & Santangelo, 2015).

However, while the writing process involves many 'high level' skills, such as planning, revision, and also flexibility, creativity... most school programmes and teachers focus on 'lower level' skills, such as the development of graphomotor gestures, just due to a lack of time, or to a lack of confidence in their ability to develop other skills (Ryan et al., 2021). Typically, teachers focus on technical writing skills rather than exploring students' emotions and creativity (Wang, 2019). International research on writing instruction suggests a decline in innovative and creative teaching practices, as teachers face pressure to focus on prescribed writing skills assessed in national assessments, leading to a product-based approach that could discourage students from writing (Stock & Molloy, 2020). Students form their attitudes toward writing during their elementary school years, and these attitudes can significantly influence their future learning, either positively or negatively. Therefore, incorporating creative writing activities in schools is essential to fostering a positive connection with writing (Göçen, 2019). A few literature reviews (Slavin et al., 2019; Barton et al., 2024) highlight the importance of a supportive writing environment, by establishing routines that foster enjoyment and motivation. To develop strong writing skills, students should feel enthusiastic about self-expression, not be afraid to make mistakes, view success as a result of effort rather than innate ability, engage in peer sharing of drafts, and work on writing tasks that are aligned with their interests and needs. In our study, we were fortunate to have an external professional lead the creative writing workshops, but for the development of this kind of practice, it would be important in the future to raise awareness among teachers about the use of creative writing. An argument to sensitive them would be, as the results of our study begin to show, that the practice of creative writing can be transferred to more general skills, allowing children to use their imagination and expand their capacity to solve problems and to think deeply. But there is still much to explore to know at what levels these possible transfer effects occur (e.g., motivational and conative factors, general knowledge and cognition, creative cognition, executive function...(Barbot et al., 2012)). Understanding these connections could strengthen the case for integrating creative writing into broader educational frameworks.

Author statement

The authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

CRedit authorship contribution statement

Cédric Hubert: Writing – review & editing, Writing – original draft, Visualization, Formal analysis, Data curation. **Nathalie Bonnardel:** Writing – review & editing, Writing – original draft. **Aline Frey:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

This work was supported by the pilot center for research in education Ampiric, funded by the France 2030 Investment Program, as part of the action “Territories of Educational Innovation» operated by the Caisse des Dépôts. This research was also supported by the INCIAM institute (Institut Créativité et Innovations d’Aix-Marseille).

Appendix

Table A1
Mean age and gender distribution for every group by year and grade.

Year	Variable	2nd grade			3rd grade			4th grade			5th grade		
		CG	SG	WG	CG	SG	WG	CG	SG	WG	CG	SG	WG
2020 - 2021	Number	16	16	16					8	8		8	8
	Average age (months)	84	84	84.8					108	108		120	120
	T-test	CG vs SG	SG vs WG	WG vs CG									
	p-value	1	0.33	0.59					1			1	
2021 - 2022	Gender	8 F	6 F	4 F					4 F	4 F		4 F	4 F
	Number	6	24	22	11	27	23						
	Average age (months)	86.8	87.6	86.1	97.3	97.1	98.8						
	T-test	CG vs SG	SG vs WG	WG vs CG	CG vs SG	SG vs WG	WG vs CG						
2022 - 2023	p-value	0.69	0.32	0.70	0.93	0.13	0.38						
	Gender	2 F	14 F	14 F	1 F	13 F	12 F						
	Number							12	25	20			
	Average age (months)							111.3	111.5	110.1			
	T-test							CG vs SG	SG vs WG	WG vs CG			
	p-value							0.87	0.34	0.45			
	Gender							6 F	9 F	7 F			

Table A2
Mean and SE for every test by group and temporality.

	control:pre	singing:pre	writing:pre	control:post	singing:post	writing:post
Dictation irregular words	2.53 (1.44)	2.54 (2.19)	2.82 (2.02)	2.47 (1.8)	2.48 (2.66)	3.04 (2.86)
Dictation regular words	3.78 (1.99)	4.07 (2.66)	4.48 (2.37)	5.22 (2.19)	4.72 (2.6)	5.3 (2.53)
Dictation pseudowords	3.8 (1.74)	4.34 (2.21)	4.46 (2.36)	5.24 (1.96)	4.67 (2.55)	5.18 (2.62)
BHK score	17.49 (7.6)	19.49 (8.48)	16.77 (8.05)	16.64 (5.76)	15.68 (7.31)	14.51 (8.71)
Verbal fluency - lexical	12.47 (4.44)	11.8 (4.84)	12.13 (5.33)	13.96 (5.78)	13.21 (4.63)	14.83 (5.28)
Verbal fluency - semantic	19.87 (4.81)	18.96 (5.24)	19.98 (6.56)	23.09 (5.12)	21.31 (5.87)	22.31 (5.95)
Similarities	18.13 (7.18)	14.17 (7.06)	15.47 (7.56)	21.82 (6.3)	19.24 (6.67)	20.24 (7.38)
EPoC - verbal div.	3.24 (1.31)	2.38 (1.49)	2.56 (1.55)	3.14 (1.32)	2.87 (1.23)	3.46 (1.27)
EPoC - verbal conv.	3.04 (1.67)	2.59 (1.64)	2.91 (1.66)	3.32 (1.31)	2.79 (1.24)	3.17 (1.42)
EPoC - graphic div.	2.65 (1.43)	2.61 (1.28)	2.46 (1.22)	2.75 (0.96)	2.76 (0.95)	2.95 (0.88)
EPoC - graphic conv.	3.27 (1.66)	3.07 (1.68)	3.13 (1.65)	3.4 (1.35)	3.05 (1.22)	3.14 (1.4)
Hipic - benevolence	35 (6.18)	33.67 (7.34)	32.22 (6.21)	34.17 (6.12)	33.26 (6.74)	31.93 (7.03)
Hipic - conscientiousness	26.24 (4.87)	27 (5.47)	25.94 (5.31)	26 (4.54)	27.03 (4.99)	25.78 (5.93)
Hipic - extraversion	17.66 (4.49)	18.67 (4.47)	17.72 (4.12)	17.93 (3.85)	19.46 (3.92)	19.48 (3.7)
Hipic - emotional stability	17.55 (4.36)	16.71 (4.22)	15.49 (3.84)	17 (3.35)	15.87 (4.48)	16.22 (4.2)
Hipic - imagination	19.03 (3.26)	19.71 (3.96)	18.8 (3.64)	18.66 (3.98)	18.61 (4.07)	19.59 (3.4)

Table A3
LMM residuals analysis for normality and homoscedasticity.

	Skewness	Kurtosis	Maximum variance : minimum variance ratio
Dictation irregular words	.94	5.93	5.33

(continued on next page)

Table A3 (continued)

	Skewness	Kurtosis	Maximum variance : minimum variance ratio
Dictation irregular words - square root transformation	-0.14	3.20	2.17
Dictation regular words	-0.09	5.13	2
Dictation pseudowords	-0.04	4.39	1.82
BHK score	.55	3.45	2.76
Verbal fluency - lexical	.38	3.14	1.61
Verbal fluency - semantic	-0.06	3.9	1.16
Similarities	-0.12	3.13	1.36
EPoC - verbal div.	.46	3.11	1.54
EPoC - verbal conv.	.61	3.29	4.17
EPoC - verbal conv. - square root transformation	-0.26	2.69	1.43
EPoC - graphic div.	.05	2.74	1.32
EPoC - graphic conv.	.45	2.62	2.01
Hipic - benevolence	-0.19	2.89	1.41
Hipic - conscientiousness	-0.20	3.01	2.25
Hipic - extraversion	.33	3.26	1.79
Hipic - emotional stability	.24	2.83	1.57
Hipic - imagination	.20	5.05	1.33

Data availability

Data supporting the findings of this study are available at the Open Science Framework:
[data_creativeWriting_OSF \(Original data\)](#)

References

- Ai, X. (1999). Creativity and academic achievement: An investigation of gender differences. *Creativity Research Journal*, 12(4), 329–337.
- Anantrasrichai, N., & Bull, D. (2022). Artificial intelligence in the creative industries: A review. *Artificial Intelligence Review*, 55(1), 589–656. <https://doi.org/10.1007/s10462-021-10039-7>
- Baer, J. (2012). Domain specificity and the limits of creativity theory. *The Journal of Creative Behavior*, 46(1), 16–29.
- Baer, J. (2015). The importance of domain-specific expertise in creativity. *Roepers Review*, 37(3), 165–178.
- Balgiu, B. A., & Adir, V. (2014). Creativity tasks and academic achievement. A study on Romanian Politehnica Undergraduate students. *Procedia-Social and Behavioral Sciences*, 116, 924–928.
- Barbot, B., Tan, M., Randi, J., Santa-Donato, G., & Grigorenko, E. L. (2012). Essential skills for creative writing: Integrating multiple domain-specific perspectives. *Thinking Skills and Creativity*, 7(3), 209–223.
- Barton, G., Khosronejad, M., Ryan, M., Kervin, L., & Myhill, D. (2024). Teaching creative writing in primary schools: A systematic review of the literature through the lens of reflexivity. *The Australian Educational Researcher*, 51(4), 1311–1330.
- Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, 67(1), 1–48. [10.18637/jss.v067.i01](https://doi.org/10.18637/jss.v067.i01).
- Beghetto, R. A. (2010). Creativity in the classroom (Eds). In J. C. Kaufman, & R. J. Sternberg (Eds.), *The cambridge handbook of creativity* (pp. 447–463). Cambridge: Cambridge University Press.
- Berlin, N., Tavani, J. L., & Besançon, M. (2016). An exploratory study of creativity, personality and schooling achievement. *Education Economics*, 24(5), 536–556.
- Bonnardel, N. (2009). Activités de conception et créativité: de l'analyse des facteurs cognitifs à l'assistance aux activités de conception créatives. *Le travail humain*, 72(1), 5–22.
- Bonnardel, N. (2012). Designing future products: What difficulties do designers encounter and how can their creative process be supported? *Work*, 41(Supplement 1), 5296–5303.
- Bonnardel, N., & Didier, J. (2016). Enhancing creativity in the educational design context: An exploration of the effects of design project-oriented methods on students' evocation processes and creative output. *Journal of Cognitive Education and Psychology*, 15(1), 80–101. <https://doi.org/10.1016/j.apergo.2019.102987>
- Bonnardel, N., & Didier, J. (2020). Brainstorming variants to favor creative design. *Applied Ergonomics*, 83, Article 102987. <https://doi.org/10.1016/j.apergo.2019.102987>
- Bonetto, E., Arciszewski, T., Pichot, N., Pavani, J.-B., Guiller, T., Girandola, T., & Bonnardel, N. (2024). Boosting scientific creativity among researchers: How efficient are creativity trainings? *Creativity: Theories – Research – Applications*, 11(1), 100–113. <https://doi.org/10.2478/ctra-2024-0007>
- Britton, J. (1970). *Language and Learning*.
- Cardebat, D., Doyon, B., Puel, M., Goulet, P., & Joannette, Y. (1990). Formal and semantic lexical evocation in normal subjects. Performance and dynamics of production as a function of sex, age and educational level. *Acta Neurologica Belgica*, 90(4), 207–217.
- Castillo-Vergara, M., Galleguillos, N. B., Cuello, L. J., Alvarez-Marin, A., & Acuña-Opazo, C. (2018). Does socioeconomic status influence student creativity? *Thinking Skills and Creativity*, 29, 142–152.
- Charles, M.; Soppelsa, R.; Albaret, J.-M. BHK, Échelle D'évaluation rapide de L'écriture chez L'enfant, eap édition; édition et application psychologique: Paris, France, 2004.
- Chiesa, M., & Hobbs, S. (2008). Making sense of social research: How useful is the Hawthorne Effect? *European Journal of Social Psychology*, 38(1), 67–74.
- Cropley, A. J. (2000). Defining and measuring creativity: Are creativity tests worth using? *Roepers Review*, 23(2), 72–79. <https://doi.org/10.1080/02783190009554069>
- Dahlin, B., & Watkins, D. (2000). The role of repetition in the processes of memorising and understanding: A comparison of the views of German and Chinese secondary school students in Hong Kong. *British Journal of Educational Psychology*, 70(1), 65–84.
- Essex, C. (1996). *Teaching creative writing in the elementary school*. ERIC Digest.
- Frey, A., Lessard, A., Carchon, I., Provasi, J., & Pulido, L. (2022). Rhythmic training, literacy, and graphomotor skills in kindergarteners. *Frontiers in Psychology*, 13, Article 959534. [10.3389/fpsyg.2022.959534](https://doi.org/10.3389/fpsyg.2022.959534).
- Gajda, A., Karwowski, M., & Beghetto, R. A. (2017). Creativity and academic achievement: A meta-analysis. *Journal of Educational Psychology*, 109(2), 269.
- Gardiner, L. (1980). *The psychology of teaching*. Belmont, CA: Brooks/Cole.

- Glaveanu, V., Lubart, T., Bonnardel, N., Botella, M., De Biais, P. M., Desainte-Catherine, M., & Zenasni, F. (2013). Creativity as action: Findings from five creative domains. *Frontiers in Psychology*, 176. <https://doi.org/10.3389/fpsyg.2013.00176>
- Göçen, G. (2019). The effect of creative writing activities on elementary school students' creative writing achievement, writing attitude and motivation. *Journal of Language and Linguistic Studies*, 15(3), 1032–1044.
- Graham, S., Harris, K. R., & Santangelo, T. (2015). based writing practices and the common core: Meta-analysis and meta-synthesis. *The Elementary School Journal*, 115(4), 498–522.
- Grahn, J. A., & Brett, M. (2007). Rhythm and beat perception in motor areas of the brain. *Journal of Cognitive Neuroscience*, 19(5), 893–906.
- Guilford, J. P. (1967). Creativity: Yesterday, today and tomorrow. *The Journal of Creative Behavior*, 1(1), 3–14.
- Gutiérrez Cisneros, A., Roussey, J., Inbar, T., Fratacci, A., & Frey, A. (2023). Impact of daily choral singing and creative writing activities on the cognitive development of second-, third-, and fourth-grade French children from low socioeconomic backgrounds. *Children*, 10(9), 1515.
- Hayes, J. R., & Flower, L. S. (1980). Writing as problem solving. *Visible Language*, 14(4).
- Hills, P., & Argyle, M. (2001). Emotional stability as a major dimension of happiness. *Personality and Individual Differences*, 31(8), 1357–1364.
- Hoffmann, J., & Russ, S. (2012). Pretend play, creativity, and emotion regulation in children. *Psychology of Aesthetics, Creativity, and the Arts*, 6(2), 175–184. <https://doi.org/10.1037/a0026299>
- Jacquier-Roux, M., Valdois, S., Zorman, M., Lequette, C., & Pouget, G. (2005). *ODEDYS: outil de dépistage des dyslexies, version 2*. Grenoble: Laboratoire cogni-sciences, IUFM de Grenoble.
- Kim, H. Y. (2013). Statistical notes for clinical researchers: Assessing normal distribution (2) using skewness and kurtosis. *Restorative Dentistry & Endodontics*, 38(1), 52–54.
- Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine*, 15(2), 155–163.
- Kumle, L., Vö, M. L. H., & Draschkow, D. (2021). Estimating power in (generalized) linear mixed models: An open introduction and tutorial in R. *Behavior Research Methods*, 53(6), 2528–2543.
- Lê, M., Quémar, P., Potocki, A., Gimenes, M., Chesnet, D., & Lambert, E. (2020). Rhythm in the blood: The influence of rhythm skills on literacy development in third graders. *Journal of Experimental Child Psychology*, 198, Article 104880.
- Leahy, A., Cantrell, M., & Swander, M. (2014). Theories of creativity and creative writing pedagogy. *The handbook of creative writing*, 11–23.
- Lopez-Bagouse, C., Arciszewski, T., & Bonnardel, N. (2024). Supporting human factors and ergonomics professionals in anticipating future work changes in response to the Anthropocene. *Ergonomics*, 1–12. <https://doi.org/10.1080/00140139.2024.2383947>
- Lubart, T., Besançon, M., & Barbot, B. (2011). *EPOC: évaluation du potentiel créatif* (p. 118). Hogrefe.
- Lucchiari, C., Sala, P. M., & Vanutelli, M. E. (2019). The effects of a cognitive pathway to promote class creative thinking. An experimental study on Italian primary school students. *Thinking Skills and Creativity*, 31, 156–166. <https://doi.org/10.1016/j.tsc.2018.12.002>
- Luke, S. G. (2017). Evaluating significance in linear mixed-effects models in R. *Behavior Research Methods*, 49, 1494–1502.
- Ma, H. H. (2006). A synthetic analysis of the effectiveness of single components and packages in creativity training programs. *Creativity Research Journal*, 18(4), 435–446.
- Marcos, R. I. S., Fernández, V. L., González, M. T. D., & Phillips-Silver, J. (2020). Promoting children's creative thinking through reading and writing in a cooperative learning classroom. *Thinking Skills and Creativity*, 36, Article 100663. <https://doi.org/10.1016/j.tsc.2020.100663>
- Mercier, M., Vinchon, F., Pichot, N., Bonetto, E., Bonnardel, N., Girandola, F., & Lubart, T. (2021). COVID-19: A boon or a bane for creativity? *Frontiers in Psychology*, 11, 3916. <https://doi.org/10.3389/fpsyg.2020.601150>
- Mervielde, I., & De Fruyt, F. (1999). Construction of the hierarchical personality inventory for children (HiPIC). In *1999. Personality psychology in Europe. Proceedings of the Eight European Conference on Personality Psychology/I. Mervielde, I. Deary, F. De Fruyt, & F. Ostendorf (Eds.)*. Tilburg: Tilburg University Press.
- Monier, F., & Droit-Volet, S. (2019). Development of sensorimotor synchronization abilities: Motor and cognitive components. *Child Neuropsychology*, 25(8), 1043–1062.
- Morley, D. (2007). *The cambridge introduction to creative writing*. Cambridge University Press.
- Pellegrin, L., Chassery, L., Chaudet, H., Texier, G., & Bonnardel, N. (2021). Decision-making during nonroutine outbreak management: Toward an exploration of experts' creative decisions. *Applied Ergonomics*, 90, Article 103232. <http://doi.org/10.1016/j.apergo.2020.103232>
- Pichot, N., Bonetto, E., Pavan, J. B., Arciszewski, T., Bonnardel, N., & Weisberg, R. W. (2022). The construct validity of creativity: Empirical arguments in favor of novelty as the basis for creativity. *Creativity Research Journal*, 34(1), 2–13. <https://doi.org/10.1080/10400419.2021.1997176>
- Plucker, J. A. (2004). Generalization of creativity across domains: Examination of the method effect hypothesis. *The Journal of Creative Behavior*, 38(1), 1–12.
- Plucker, J. A., Beghetto, R. A., & Dow, G. T. (2004). Why isn't creativity more important to educational psychologists? Potentials, pitfalls, and future directions in creativity research. *Educational Psychologist*, 39(2), 83–96.
- Plucker, J.A., Waitman, G.R., & Hartley, K.A. (2011). Education and creativity. In M. A. Runco & S. R. Pritzker (Eds.), *Encyclopedia of creativity* (pp. 435–440). Elsevier.
- Quartier, V., & Rossier, J. (2008). A study of personality in children aged 8–12 years: Comparing self-and parents' ratings. *European Journal of Personality*, 22(7), 575–588.
- Rocher, T. (2016). Construction d'un indice de position sociale des élèves. *Éducation & Formations*, (90), 5–27.
- Rossier, J., Quartier, V., Enescu, R., & Iselin, A. (2007). Validation of the french version of the hierarchical personality inventory for children (HiPIC). *European Journal of Psychological Assessment*, 23(2), 125–132.
- Ruiz-del-Pino, B., Fernandez-Martin, F. D., & Arco-Tirado, J. L. (2022). Creativity training programs in primary education: A systematic review and meta-analysis. *Thinking Skills and Creativity*, 46, Article 101172.
- Ryan, M., Khosronejad, M., Barton, G., Kervin, L., & Myhill, D. (2021). A reflexive approach to teaching writing: Enablers and constraints in primary school classrooms. *Written Communication*, 38(3), 417–446.
- Said-Metwaly, S., Van den Noortgate, W., & Kyndt, E. (2017). Methodological issues in measuring creativity: A systematic literature review. *Creativity. Theories—Research—Applications*, 4(2), 276–301. <https://doi.org/10.1515/ctra-2017-0014>
- Scoffham, S., & Barnes, J. (2011). Happiness matters: Towards a pedagogy of happiness and well-being. *Curriculum Journal*, 22(4), 535–548.
- Scott, G., Leritz, L. E., & Mumford, M. D. (2004). The effectiveness of creativity training: A quantitative review. *Creativity Research Journal*, 16(4), 361–388.
- Silvia, P. J., Beaty, R. E., & Nusbaum, E. C. (2013). Verbal fluency and creativity: General and specific contributions of broad retrieval ability (Gr) factors to divergent thinking. *Intelligence*, 41(5), 328–340.
- H. Singmann, B. Bolker, J. Westfall and F. Aust (2016). *afex: Analysis of Factorial Experiments*. R package version 0.16-1. <https://CRAN.R-project.org/package=afex>.
- Slavin, R.E., Lake, C., Inns, A., Baye, A., Dacht, D., & Haslam, J. (2019). A quantitative synthesis of research on writing approaches in years 3 to 13.
- Smith, J. K., & Smith, L. F. (2010). Educational psychology (Eds.). In J. C. Kaufman, & R. J. Sternberg (Eds.), *The cambridge handbook of creativity* (pp. 250–264). New York: Cambridge University Press.
- Sundquist, D., & Lubart, T. (2022). Being intelligent with emotions to benefit creativity: Emotion across the seven Cs of creativity. *Journal of Intelligence*, 10(4), 106. <https://doi.org/10.3390/jintelligence10040106>
- Sternberg, R. J., & Lubart, T. I. (1999). *The Concept of Creativity: Prospects and Paradigms*.
- Stock, C., & Molloy, K. (2020). Where are the students?: Creative writing in a high-stakes world. *Idiom*, 56(3), 19–20.
- Tabachnick, B.G., Fidell, L.S., & Ullman, J.B. (2013). *Using multivariate statistics* (Vol. 6, pp. 497–516). Boston, MA: Pearson.
- Tan, M., Mourgues, C., Bolden, D. S., & Grigorenko, E. L. (2014). Making numbers come to life: Two scoring methods for creativity in Aurora's Cartoon Numbers. *The Journal of Creative Behavior*, 48(1), 25–43.
- Valois, P., Forget, J., & Ponton, C. (2020). Literature review of Francophone psychometric tests of creativity: Guiding school psychologists. *Canadian Journal of School Psychology*, 35(1), 57–82.

- Vijetha, P., & Jangaiah, C. (2010). Intelligence, creative thinking abilities and academic achievement of children with hearing impairment-a correlation study. *Journal of the All India Institute of Speech & Hearing*, 29(2).
- de Vries, H. B., & Lubart, T. I. (2019). Scientific creativity: Divergent and convergent thinking and the impact of culture. *The Journal of Creative Behavior*, 53(2), 145–155.
- Vygotsky, L. S. (2004). Imagination and creativity in childhood (M. E. Sharpe, Inc., Trans.). *Journal of Russian and East European Psychology*, 42, 7–97 (Original work published 1967).
- Wang, L. (2019). Rethinking the significance of creative writing: A neglected art form behind the language learning curriculum.
- Weisberg, R., Pichot, N., Bonetto, E., Pavani, J.-B., Arciszewski, T., & Bonnardel, N. (2021). From explicit to implicit theories of creativity and back: The relevance of naive criteria in defining creativity. *Journal of Creative Behavior*, 55, 839–856. <https://doi.org/10.1002/jocb.492>
- Wechsler, D. WISC V—Échelle D'intelligence de wechsler pour enfants et adolescents, 5th ed.; les Éditions du centre de psychologie appliquée: Paris, France, 2016.
- Whitall, J., Chang, T. Y., Horn, C. L., Jung-Potter, J., McMenamin, S., Wilms-Floet, A., & Clark, J. E. (2008). Auditory-motor coupling of bilateral finger tapping in children with and without DCD compared to adults. *Human Movement Science*, 27(6), 914–931.
- Yang, J., & Zhao, X. (2021). The effect of creative thinking on academic performance: Mechanisms, heterogeneity, and implication. *Thinking Skills and Creativity*, 40, Article 100831.