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Programs to stimulate creativity in schools: a systematic review

Programas de estímulo à criatividade em escolas: uma revisão sistemática

Programas de estímulo de la creatividad en escuelas: una revisión sistemática

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Highlights

This study investigated methods and results of programs to stimulate creativity developed with students.

Most of the programs consisted of five to six sessions.

All the studies analyzed identified in their results positive effects.

Abstract

The objective of this research was to analyze methods and results of programs that stimulate creativity developed with elementary school students through a systematic review of publications from 2018 to 2022. The search was performed in the databases of Google Scholar, Portal de Periódicos da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and Education Resources Information Center (ERIC). We selected and analyzed 26 articles. The review resulted that the programs had a positive effect associated mainly with the characteristics of creative thinking and creative behavior such as fluency, flexibility and originality.

Resumo | Resumen

Keywords

Systematic Review. Creativity. Programs. Students. Elementary School.

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Creativity, since the beginning, has been considered one of the central dimensions for human evolution, existence and fulfillment and for the social and economic development of societies (Maldonato & Dell'Orco, 2016; Neves-Pereira & Alencar, 2018). In this way, its promotion has been a theme that has been increasingly arousing the interest of researchers, educators and governmental and non-governmental instances around the world (Patston et al., 2021).

Since creativity is considered a skill that can be developed, studies have pointed out that the ability to create can be expanded through programs, interventions, and trainings by using specific methods, techniques, exercises, and strategies (Nakano, 2011; Lucchiari et al., 2019). The objective of these interventions is to develop abilities that favor creativity in the individual, through the stimulation of creative attitudes and behaviors, carried out both in groups and individually.

Although classrooms have sometimes been characterized as spaces that suppress or inhibit students' creativity, schools can also be promising environments for its development (Beghetto, 2021). The stimulus to the apprenticeship in the school environment contributes to the student to develop and express simultaneously their creativity through the search for innovative solutions, the problematization of the information received, the curiosity and the elaboration of their knowledge (Martinez, 2002).

Specific programs to stimulate creativity in school environments have also been recurrent, becoming an additional tool to promote students' creativity. Wechsler and Nakano (2011) point out that the benefits of these programs can be noticeable in all students, considering their different abilities levels. Systematic reviews conducted over the last decades to evaluate the impact of programs on creativity also assess their effectiveness in the development of creative thinking in children, adolescents, and adults (Scott et al., 2004; Nakano, 2011; Valgeirsdottir & Onarheim, 2017; Alves-Oliveira et al., 2021).

The method to be applied during the programs – techniques used, content covered, duration time and forms of evaluation – enables the strengthening of values, attitudes, beliefs, and behaviors that will possibly contribute to the individual thinking in a flexible, imaginative, and independent way. In this context, training programs and stimulation of creativity, in addition to being considered increasingly popular, have also been pointed to positive results with regard to the development of individuals' creative abilities (Lucchiari et al., 2019; Ozkan & Topsakal, 2019). In this sense, this systematic review aimed to investigate the methods and results of programs to stimulate creativity developed with elementary school students through a systematic review of publications from 2018 to 2022.

Method

This systematic review was conducted to investigate the effects of programs to stimulate creativity conducted with elementary school students in educational environments. Identification of the studies included in this systematic began by identifying articles and consisted of the downtrace of studies published between

2018 and 2022 in the Google Scholar databases, CAPES Journal Portal and ERIC portal. The following codes were used as descriptors: ("creativity intervention", OR "creativity program", OR "creativity training"), AND "elementary school", AND "student". In total, 743 articles were found.

The second step covered the procedures for selecting articles and consisted of reading the titles of the 743 publications located, to verify if there was overlap of studies. In the 743 articles found, most came from the Academic Google database (n=732; 98.52%), followed by the CAPES (n=6; 0.8%) and the ERIC (n=5; 0.68%) databases. In a first analysis, three publications (0.4%) were excluded because they were duplicated, and 714 articles (96.1%) involving theoretical studies, literature reviews, systematic reviews, meta-analyses, dissertations, theses, publications in languages other than English and studies conducted with teachers, high school students, university students and kindergarten students.

The third step consisted of reading and analyzing the abstracts of the 26 articles that contemplated the following pre-established inclusion criteria: (a) empirical study; (b) investigation of the effects of training, interventions, or programs to stimulate creativity and, (c) a study conducted with elementary school students or equivalent. In the 26 articles included, 23 (88.5%) came from the Google Scholar database, two (7.7%) from the CAPES portal and only one (3.8%) from the ERIC database. Finally, the fourth step, which consisted of an in-depth reading of the selected articles, during which, the characterization and analysis of the 26 studies was carried out, considering the following categories: (a) year of publication, (b) target audience (students' school grade), (c) duration of the programs, (d) techniques used, (e) pre /post-tests, (f) instruments for evaluation of creativity and (g) results of the researches analyzed.

Results

The findings of the year of publication category indicated the following results: 2018 (n=2), 2019 (n=9), 2020 (n=6), 2021 (n=7), 2022 (n=2). In the target audience category (the school grade of elementary school in which the program was developed) the result found was: 1st grade (n=3), 2nd grade (n=3), 3rd grade (n=6), 4th grade (n=9), 5th grade (n=6), 6th grade (n=5), 7th grade (n=3) and five studies did not indicate the target audience. The results of the target audience category exceed the number of articles (n=26) because some of the studies were conducted with groups of participants from more than one school grade.

The duration of interventions category considered the number of sessions performed during the programs. The results found were: 1 session (n=1), 2 sessions (n=2), 3 sessions (n=1), 4 sessions (n=1), 5 sessions (n=4), 6 sessions (n=4), 8 sessions (n=1), 10 sessions (n=3), 11 sessions (n=1), 12 sessions (n=1), 14 sessions (n=1), 16 sessions (n=1), 24 sessions (n=1), 28 sessions (n=1) and three studies did not specify their number of sessions. Regarding the techniques used, the results found were: activities that involved some type of creative reading/writing (n=5), activities with the STEAM methodology (n=3), activities with the use of virtual technologies (n=3), mathematical activities (n=3), activities with

the use of games (n=2) and other diversified activities throughout the interventions (n=10). The category of pre/post-tests indicated that 23 studies performed pre/post-tests, and three studies, only post-tests.

Regarding the instruments used to assess creativity, the results were: Six studies used the Torrance Test of Creative Thinking (TTCT) and three studies used the Creative Imagination Test for Children. The other instruments listed below were used in only one study: (1) Divergent Thinking Test, (2) Creative Tendency Scale, (3) Creative Imagination Test for Children – PIC-N, (4) Creative Assessment Battery – rCAB, (5) Test of evaluation of children's motor creativity elaborated by Bertsch, (6) The Assessment of Children's Emotion Skills, (7) Children Completed an Alternate Uses Task, (8) Construction Tasks, (9) Figural Exercises – NTCT-Figural, (10) The Williams Assessment of Creative Tendency, (11) Elementary School Student Self-Concept Scale, (12) Evaluation of Potential for Creativity, (13) Creative Potential Questionnaire, (14) Scientific Creativity Test, (15) California Critical Thinking Skills Test, (16) Falsafi Media Literacy Questionnaires , (17) Consensus Assessment Technique, (18) How creative are you? , (19) Creative problem-solving abilities, (20) Alternate Uses task, (21) adapted version of Cued Drawings, (22) *Test di Creatività Infantile,* (23) Test D2, (24) Difference Perception Test – FACE-R, (25) Immediate auditory memory test, (26) Grid Point Average, (27) Biographical Inventory of Creative Behaviors, (28) Inventory of Self-determination in Digital Games, (29) Inventory of Flow Experience in Digital Games s, (30) Inventory of Mastery Experience in Creativity Digital Games, (31) Academic achievement tests. Nine studies indicated that they used other authorial unnamed instruments, like questionnaires, interview scripts, tests, and protocols. The number of instruments exceeds the number of articles (n=26) because many studies have used more than one instrument to perform their assessments.

All studies indicated positive results on the programs implemented with the students. The results showed significantly higher scores regarding the following: creativity – without specification of a dimension/domain/category/characteristic (n=10), creative thinking – without specification of a dimension/domain/category/characteristic (n=5), flexibility (n=5), originality (n=4), fluency (n=3), divergent thinking – without specification of a dimension/domain/category/characteristic (n=2), academic performance (n=2), ability to solve mathematical problems (n=2) and motivation (n=2). The other results pointed out by the studies and reported below had only one occurrence each: mastery (of the activity), cognitive creativity, motor creativity, motivation, creative tendency, self-concept, critical thinking, creative skills, idea generation, concentration, memory, perception, confidence, self-efficacy, and conscious learning.

Description of the studies analyzed

The study by Chen et al. (2020) sought to develop and evaluate the effects of a gamified classroom management program on student creativity. The program lasted 11 sessions and had the participation of 86 students of the 4th grade of elementary

school, divided into two groups: experimental (n=44) and control (n=42). To assess creativity, the instruments Divergent Thinking Test (Wu et al., 1998, as cited in Chen et al., 2020) and Creative Tendency Scale (Lin & Wang, 1994, as cited in Chen et al., 2020) were used . The results showed that, after the program, the experimental group had a better performance in relation to the control group in fluency, flexibility, and originality in divergent and verbal thinking.

The research developed by Marcos et al. (2020) sought to investigate whether students' creative thinking can be improved through a program of reading and writing activities and to test a possible correlation between critical thinking and academic performance. 60 students of the 5th grade of elementary school participated in the study: half of the students were part of the experimental group and the other half of the control group. Creative thinking was assessed through the Creative Imagination Test for Children (Corbalán et al., 2003, as cited in Marcos et al., 2020) and the academic assessment through the Grade Point Average. The results revealed a significant increase in creativity scores in the experimental group in comparison to control, and a moderate positive correlation between creative thinking and academic performance.

The study conducted by Zhao (2019) aimed to build and evaluate a model of creativity training for elementary school students (grade unspecified) in an intelligent learning environment. The training lasted three sessions. Pre/post-tests were performed. A total of 30 students participated in the study, and there was no control group. To assess creativity, the Torrance Test of Creative Thinking (Torrance, 1974, as cited in Zhao, 2019) was used. The results indicated significant differences in the three indicators evaluated (fluency, flexibility, and originality) when comparing the pre-test with the post-test performed with the experimental group.

The aim of the study developed by Moghadam and Ardakanian (2019) was to investigate the effects of a program on the students’ creativity. The program had six sessions and the research sample was composed of 60 elementary school students, divided into four groups of 15 participants each. Of the four groups, three were part of the experimental groups and one of the control group. To assess creativity, only the post-test was conducted with all groups with the Torrance Test of Creative Thinking instrument (Torrance, 1974, as cited in Moghadam & Ardakanian, 2019). The results showed significant differences in creativity when comparing students from the experimental groups and the control groups.

The research conducted by Betancourt et al. (2022) aimed to investigate differences in creativity between boys and girls and to evaluate the effects of a program on creativity with gifted students. The sample consisted of 105 students, from the 1st to the 6th grade of elementary school, and all were members of the experimental group. Pre and post-tests were performed. The instruments used to measure creativity were the Creative Imagination Test for Children (Corbalán et al., 2003, as cited in Moghadam & Ardakanian, 2019) and the Creative Imagination Test for Children - PIC-N. Students participated in that program for one school year. The results indicated no significant differences in creativity when comparing boys and girls, and pointed out that the program contributed to improvements in the

components fluency, flexibility and originality in the narrative area, elaboration, shadows and colors, and special graphic details.

Yeh et al. (2019) conducted a study that purported to develop and evaluate a program in creativity for the promotion of conscious learning, self-efficacy, and mastery of creativity. The program, titled Digital Game-based Learning of Creativity, consisted of nine educational virtual games, and lasted six sessions. A total of 83 5th and 6th grade students participated in the study. There was no control group. For data collection, the researchers developed four types of protocols. The results showed that the use of games can facilitate the experience of conscious apprehension, self-efficacy, and mastery during creativity.

Richard et al. (2018) conducted a study whose goal was to test the effectiveness of a creative physical education exercise program on children's motor and cognitive creativity. The program consisted of 10 sessions. A total of 140 students from the 4th grade of elementary school participated in the study. The experimental group consisted of 64 students and the control group consisted of 76. The instruments used in the research were: Creative Assessment Battery – rCAB (Runco, 2011, as cited in Richard et al., 2018), and a test that assesses children's motor creativity (Bertsch, 1983, as cited in Richard et al., 2018). After the program, the students in the experimental group experienced greater originality in thinking and greater fluency and flexibility of movement than the children in the conventional program.

Hoffmann et al. (2020) aimed to evaluate the effects of a program whose goal was to increase students' creative skills and emotional skills in the visual arts. The program lasted six sessions. The study included 64 students from the 4th to the 6th grade of elementary school divided into two groups: experimental (n=29) and control (n=35). The instruments used during the research were: The Assessment of Children's Emotion Skills (Schultz et al., 2004, as cited in Hoffmann et al., 2020), Children Completed an Alternate Uses Task (Wallach & Kogan, 1965, as cited in Hoffmann et al., 2020), Construction Tasks (Baer, 1988, as cited in Hoffmann et al., 2020) and Biographical Inventory of Creative Behaviors (Batey, 2007, as cited in Hoffmann et al., 2020). The results showed positive effects in the experimental group, when related to the common group, in relation to emotional skills, generation of ideas (fluency and originality) and discovery of problems (only in fluency).

The study conducted by Liao et al. (2018) investigated the impact of creativity pedagogy on learning performance, creativity, and motivation to learn in the foreign language classroom. The sample consisted of 256 elementary school students: experimental group (n=119) and control group (n=137). An intervention of 14 sessions was carried out. To assess the effects of the intervention, three instruments were used: Receptive Vocabulary Test of English, Torrance Test of Creative Thinking (Torrance, 1974, as cited in Liao et al., 2018) and Learning Motivation Questionnaire in English. The results of the one-way analysis of covariance indicated that the intervention contributed significantly to the students' performance in English language learning, creativity and learning motivation.

The research conducted by Awan et al. (2021) had as main objective to evaluate the effect of an intervention in creativity on the fluency and originality of students' ideas. The sample consisted of 60 participants, all elementary school students (grade not specified). A half of the sample composed the control group and the other half the experimental group. The intervention lasted 24 sessions. They were performed before and after the test with an authorial instrument that sought to evaluate the knowledge, fluency and originality of the students' ideas. The results showed that the experimental group had a significant increase in creative thinking with regard to fluency and originality.

Huang et al. (2021) conducted a study whose objective was to develop and evaluate a program of stimulation to creative thinking. The researchers looked at how the program influenced participants' creativity, creative tendencies, and self-concept. The program lasted eight sessions. The sample consisted of 133 students from the 7th grade of elementary school, 67 participants from the experimental group and 66 from the control group. For data collection, pre and post tests were performed. The instruments used were: NTCT – Figural Exercises, The Williams Assessment of Creative Tendency and Elementary School Student Self-Concept Scale. The results showed that the experimental group had significantly higher scores when compared to the control group in creativity, creative tendency, and self-concept.

Astini et al. (2020) conducted a study that aimed to analyze a program that used problem-solving-based mathematical learning tools to stimulate students' creativity. The study included 30 students from elementary school (grade not specified), all participants in the experimental group. Students were evaluated before and after the program. The program lasted two sessions. The instruments used for data collection were the protocol of validation of the learning device, the script of observation of the teaching and student activity, the test of student creativity and the test of evaluation of the learning outcome. The results showed that the creativity of the students increased significantly after the completion of the program.

The study developed by Cheng et al. (2021) aimed to examine the effectiveness of a creativity training program focusing on dialogic reading based on books with illustrations. The training lasted five sessions of 20 minutes each. An eight-year-old student, from the 3rd grade of elementary school, participated of this study. Pre and post-tests were performed. Data collection was performed using two measures: Evaluation of Potential for Creativity and Creative Potential Questionnaire. The results indicated that linguistic divergence, graphic divergence, and linguistic convergence scores increased significantly after the interventions.

Tran et al. (2021) conducted a study whose objective was to evaluate a program based on the Science, Technology, Engineering, Arts and Mathematics (STEAM) methodology on the scientific creativity of students. A total of 66 elementary school students participated in the study, divided equally into the experimental (n=33) and control (n=33) groups. The program was divided into two phases: Phase 1 (Lock Science Courses) and Phase 2 (STEAM-based courses). Each phase lasted two weeks and the groups had to participate in both. The control group did first Phase 1

and then Phase 2, while the experimental group did the reverse order. Pre and post tests were performed with both groups with the Scientific Creativity Test. The findings of the study indicated that both the control group and the experimental group showed significant improvement in scientific creativity regarding fluency and flexibility. In terms of originality, there was no change.

The aim of Senel's (2019) study was to evaluate the effects of a program on students' creativity and creative thinking skills. The program lasted five sessions and consisted of the development of creative writing activities in magazines. 67 students of the 3rd grade of elementary school divided into three groups (Experimental Group, Control Group A, Control Group B) participated in the research. For data collection, the pre and post-test of the Torrance Test of Creative Thinking (Torrance, 1974, as cited in Senel, 2019) were performed. According to the findings, the activities contributed positively to the development of the creative thinking skills of the students of the experimental group.

The research conducted by Khoorchani et al. (2019) aimed to investigate the effectiveness of a training to stimulate creative thinking in the formation of critical thinking and media literacy of students. During the training, the Creative Thinking Training Package of Karami (2016) was used. The study was conducted with 40 students from the 6th grade of elementary school, 20 from the control group and 20 from the experimental group. Pre and post-tests were performed using the following instruments: California Critical Thinking Skills Test and Falsafi Media Literacy Questionnaires. The results indicated a significant difference between the two groups in critical thinking and media literacy.

The goal of the research conducted by researchers Leasa et al. (2021) was to analyze the effects of implementing a program in creativity based on Problem-based learning (PBL) on the correlation between students' problem-solving skills and creative thinking. The program lasted five sessions of 35 minutes each. The sample of participants was composed of 33 students of the 5th grade of elementary school, all of whom were part of the experimental group. Data collection was performed through problem-solving tests and creative thinking skills in the concept of the human circulatory system. The results showed a correlation of 37.8% between creative thinking and problem-solving skills after the program.

Cheng, et al. (2022) sought to verify the effectiveness of a creativity development program based on the STEAM methodology. The program lasted six sessions. A total of 66 students from the 4th grade of elementary school participated in the study. The students were divided into two groups: experimental (n=33) and control (n=33). To assess creativity, students took pre and post-tests through the following instruments: Divergent Thinking Test, Consensus Assessment Technique, creative self-efficacy measure, creative project carried out in a group and knowledge test. The results showed that, compared to the control group, the creativity of the students in the experimental group improved significantly during and after the program, both at the individual and group level.

The study by Ertürkler and Bağcı (2019) aimed to assess the impact of the Enriched Creative Activities Program with the *Aytürk* Technique on students' creative thinking skills. The program lasted ten sessions of 40 minutes each. 33 students from two classes of the 4th grade of elementary school participated in the study. Only the experimental group, composed of 18 students, participated in the program. To evaluate creativity, pre and post-tests were performed for the middle of the instrument How creative are you? (Raudsepp, 1983, as quoted in Ertürkler & Bağcı, 2019). The results showed significant differences between the pre-test and post-test scores of the experimental group and between the post-test scores of the experimental group compared to those of the control group, indicating that the experiment was successful.

Ozkan and Topsakal (2019) conducted a study whose objective was to evaluate a creativity-stimulating program developed based on the STEAM methodology. The study lasted 11 weeks (4 hours per week). 74 students of the 7th grade of elementary school participated in the research. They were divided into two groups, experimental and control, each composed of 37 participants. With the experimental group, nine activities were developed using the STEAM methodology. For data collection, the Torrance Test of Creative Thinking was used (*Torrance*, 1974, as cited in Ozkan & Topsakal, 2019). Significant differences were found in favor of the experimental group, both in terms of verbal and figural creativity. The researchers make recommendations for the implementation of the STEAM methodology in educational curricula.

Sipayung et al. (2021) evaluated the creative mathematical problem-solving skills of students after conducting a creativity-stimulating program conducted through videos in mathematical comic books. All students in the 7th grade of elementary school (total number not specified) of a school participated in the study. One class of students composed the experimental group and the other the control group. For data collection, pre and post tests were performed using the Creative problem-solving abilities instrument. The results showed significant differences in favor of the experimental group in the creative abilities of solving mathematical problems.

Yeh et al. (2020) conducted a survey to evaluate a program for the development of creativity based on learning with the use of games. The program consisted of nine games. 82 students of the 3rd and 4th grade of elementary school participated in the study. The study had no control group. Data collection was performed through three instruments: Inventory of Self-termination in Digital Games, Inventory of Flow Experience in Digital Games and Inventory of Mastery Experience in Creativity Digital Games (Yeh & Lin, 2018, as cited in Yeh et al., 2020). The results showed that the participants perceived the training in a positive way, considered the games interesting and believe that there was an improvement in creativity. In addition, the students pointed out that encouraging feedback, rewards, and freedom to choose the order of achievement of the games contributed to their motivation, creativity, and confidence during the game.

The study conducted by Fakhrou and Ghareeb (2020) sought to explore the effectiveness of a program in creativity entitled Creativity Lamp in academic

performance and in promoting the creativity of students. The sample of participants was composed of 26 students from the experimental group and 25 students from the control group, totaling 51 students. The program lasted one semester and consisted of several extracurricular activities. Pre and post-tests were conducted with both groups using the instruments: Academic achievement tests and Torrance Test of Creative Thinking (Torrance, 1974, as cited in Fakhrou & Ghareeb, 2020). The results showed that the proposed program had a statistically significant impact on students' academic performance and creativity as well.

Fink et al. (2019) investigated the effects of different types of creative interventions on students' creative potential. The training lasted two sessions and aimed to develop the verbal and figural creativity of the children through six games with tasks to be performed. 77 students from four classes of the 4th grade of elementary school participated in the study. Two classes received verbal training and the others received figural creativity training. For data collection, pre and post-tests were performed through an adaptation of the Alternate *Uses* task instrument (Guilford, 1967, as cited in Fink et al., 2019) and an adapted version of Cued Drawings (Krampen et al., 1996, as cited in Fink et al., 2019). The results showed that verbal training increased the capacity for verbal and figural divergent thinking, but not the creative potential in the conclusion of the story and in the task of painting pictures.

The objective of the research conducted by Lucchiari et al. (2019) was to present the effects of a training in creativity carried out collectively with children of the 2nd and 3rd grade of elementary school. The training consisted of 10 sessions of one hour each. The main factor observed before, during and after the training was the students' ability to produce new ideas. The participants were divided into the groups: control group (n=44) and experimental group (n=180), totaling 224 students. To evaluate the creative potential of the students individually, the instrument *Test di Creatività Infantile* (TCI) was used. From this individual evaluation, some items were extracted to measure the group's creativity (gTCI). The sample was tested before and after training. The results indicated the effectiveness of the training, demonstrating that only the experimental group presented a significant increase in the ability to produce new ideas.

León et al. (2021) analyzed the effects of a training in creativity that focused on the benefits of mathematical calculations performed with the use of the *abacus* on concentration, attention, memory, perceptual attitudes and cognitive abilities of creativity. The program lasted 16 sessions and consisted of exercises to be performed by the students through the *abacus.* 65 students from the 1st to 5th grade of elementary school participated in the study. The children were randomly assigned to a control group (n=34) and an experimental group (n=31). For data collection, the following instruments were used: D2 Test (Spanish version), Difference Perception Test (FACE-R), Immediate auditory memory test (AIM) and Creative Imagination Test for Children (Corbalán et al., 2003, as cited in León et al., 2021). The results indicated significant improvements in the cognitive parameters of the experimental group with regard to concentration, memory, perceptual attitudes and creativity after the intervention, compared to the control group.

Discussion

This systematic review analyzed empirical studies that evaluated the effects of training, interventions, and programs to stimulate creativity conducted with elementary school students in the last five years (2018-2022). According to Scott et al. (2004), the comparison of the effectiveness of different types of programs and training are important because they point out strengths and weaknesses of different methodological designs and, at the same time, identify promising new methodologies.

The findings of this research indicated that most of the studies analyzed were published in the years 2019 (n=9; 34.6%) and 2021 (n=7; 26.9%). Of the studies that indicated the school grade in which the program was implemented, the 4th grade of elementary school was the one that obtained the highest number (n=9; 34.6%). This number considers studies conducted only with 4th grade students and studies conducted with 4th grade students together with students from other school grades. According to Falconer et al. (2018), a research conducted in the last 30 years has pointed out that levels of creativity, especially in young children, are declining. According to the authors, a longitudinal study conducted by Torrance from 1959 to 1964 pointed to a drop in the creativity of children in the 4th grade of elementary school, also called the "Fourth grade slump in creativity". Although Torrance's study is not current, the authors point out that recent research has shown similar results.

Regarding the most recurrent techniques, the results of this review indicated that most studies adopted reading and creative writing activities (n=5), made use of some type of virtual technology (n=3), performed activities related to the teaching/learning of mathematics (n=3) or used the STEAM methodology (n=3). Education based on the STEAM methodology integrates five areas of knowledge: science, technology, engineering, art and mathematics, and has often been used by educators around the world since it proposes to students an environment to discuss and propose solutions to problem situations, generating positive effects on students' creativity (Ozkan and Topsakal, 2019).

Most of the programs performed between five (n=4) and six (n=4) sessions and most worked with a quasi-experimental design with experimental group and control group (n=18), and with pre and post-test (n=23). Regarding the instruments for data collection, most studies used more than one instrument (n=17) to measure creativity. Among the most used are the Torrance Test of Creative Thinking (n=6) and Creative Imagination Test for Children (n=3). TTCTs are among the most widely used tests in the world to measure creativity (Valgeirsdottir & Onarheim, 2017). Alves-Oliveira et al. (2021) highlight that the use of pre and post-tests has been used by most studies that aim to measure the effects of programs to stimulate creativity. However, although the tests present important results for measuring creativity, only the use of them cannot evaluate the entire complex creative process (Alves-Oliveira et al., 2021). Measuring creativity is still a great challenge, since it

means trying to build a standardized way of capturing human creativity that, paradoxically, escapes standardization (Oliveira, 2010).

Finally, all the studies analyzed identified positive effects in the programs performed, related, in general, to increased creativity (n=10), creative thinking (n=5), flexibility (n=5), originality (n=4) and fluency (n=3). The fluency, flexibility and originality dimensions have been used in several tests such as the Brazilian Test of Child Figural Creativity (Nakano et al., 2011; Nakano & Primi, 2012; Nakano & Wechsler, 2006) and the Torrance Tests of Creative Thinking, which initially distinguished only four dimensions of creative thinking: fluency, flexibility, originality, and elaboration (Kim, 2006, 2011; Wechsler & Nakano, 2020).

Conclusion

The results of this study found positive and significant effects in relation to the implementation of programs, training and/or interventions in creativity carried out in schools. In this sense, we believe that this can be an important tool for the stimulation and development of creativity of individuals during childhood in educational environments.

We highlight as relevant and positive results of the analyzed programs (1) the diversified methodologies and dynamics during the sessions; (2) the comparison of the results obtained through the instruments used between the experimental and control groups; (3) the introduction of technologies and interactive games that seem to arouse the interest of the participants during the performance of the activities throughout the sessions and, (4) the reduced number of sessions, which, in general, was the one of around five and six, seems appropriate for this type of research and intervention.

According to Nakano (2011), there is today a divergence between the types of interventions focusing on stimulating creativity, especially with regard to the research plans, sample sizes and methodologies employed. A research conducted by the author, whose objective was to review scientific production about the impact of training programs on creativity, pointed out that the effectiveness of these has, in general, been measured when comparing training groups and control groups, being more common the evaluation of the creativity of the participants at the beginning and after the end of the programs through traditional tests.

Regarding the use of technologies, studies have indicated that emerging technologies have a positive impact on students' creativity, particularly in interactive learning environments (Li et al., 2022). On the other hand, the programs performed with a greater number of sessions did not present more significant results when compared to programs with a reduced number of sessions, which sometimes represents an economy of materials (physical, technological and human). According to Alves-Oliveira et al. (2021), the field still lacks everything that addresses and compares results of programs in creativity carried out in the long-term, medium and short term.

Another relevant point that deserves to be appreciated is the fact that most of the studies analyzed focus their programs and interventions on the 4th grade of elementary school. Falconer et al. (2018) point out that many scholars have agreed with Torrance's premise of the " Fourth grade slump in creativity," which may explain, in part, the focus of researches at this level of education. However, studies are still needed to evaluate other reasons that lead researchers to choose the 4th grade of elementary school to carry out the programs and interventions.

We also emphasize that the studies presented a wide variety of methods, techniques, and instruments for the evaluation of creativity, which hinders the possible comparison of the results obtained among the programs. As Oliveira (2010) pointed out, the measurement of creativity is still considered a great challenge and, according to Nakano (2011), inevitably controversial, given the diversity of definitions and modes of measurement of the phenomenon.

One gap identified is that few studies have focused on the development of creativity to solve social or environmental problems. Only the three studies that used the STEAM methodology were somehow tangential to this proposal. Preparing citizens to identify and solve future problems is fundamental and indispensable to today's societies (Valgeirsdottir & Onarheim, 2017; Neves-Pereira & Alencar, 2018). According to Csikszentmihalyi (1996), in the future, it will not be enough just to be creative; it will also be important to know how to evaluate the impact of creativity on the world. We suggest that the conduction of future programs and research to stimulate creativity should be related to the real problem situations of the students so that, in this way, they can contribute effectively to the generation of ideas and resolution of current and future socio-environmental problems.

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Resumo

O objetivo desta pesquisa foi analisar métodos e resultados de programas de estímulo à criatividade desenvolvidos com estudantes do Ensino Fundamental por meio de uma revisão sistemática de publicações entre os anos de 2018 e 2022. A busca foi realizada nas bases de dados Google Acadêmico, Portal de Periódicos da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) e *Education Resources Information Center* (ERIC). Foram selecionados e analisados 26 artigos cujos resultados revelaram que os programas tiveram efeitos positivos associados principalmente às características do pensamento criativo como fluência, flexibilidade e originalidade.

Palavras-chave: Revisão Sistemática. Criatividade. Programas. Estudantes. Ensino Fundamental.

Resumen

El objetivo de esta investigación fue analizar métodos y resultados de programas de estímulo de la creatividad desarrollados con los alumnos de la Enseñanza Fundamental a través de una revisión sistemática de publicaciones entre 2018 y 2022. La búsqueda se realizó en las bases de datos Google Scholar, *Portal de Periódicos da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (CAPES) y *Education Resources Information Center* (ERIC). Se seleccionaron y analizaron 26 artículos, cuyos resultados revelaron que los programas tuvieron un efecto positivo, principalmente asociado a las características del pensamiento creativo como fluidez, flexibilidad y originalidad.

Palabras clave: Revisión Sistemática. Creatividad. Programas. Estudiantes. Enseñanza Básica.

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