

Article

Enhancing Creativity: Using Visual Mnemonic Devices in the Teaching Process in Order to Develop Creativity in Students

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Abstract: (1) Background: In the field of creativity studies there is always space for expansion and new conceptualizations of the methods involved. Therefore, we will present in this paper a brief arrangement of the methods used to enhance creativity and consider whether visual mnemonic devices can increase creativity. The devices are used in the teaching process in order to ease the remembering process by creating a visual representation. Visual mnemonic devices are techniques that increase creativity as part of their own performance. (2) Methods: We will use a quasi-experimental, nonequivalent group design, the procedure involving the use of visual mnemonic devices. (3) Results: The results show that the degree of abstracting increased after using visual mnemonic devices, along with fluency and other creativity dimensions. (4) Conclusions: The paper shows that the creativity increased, based on a national percentile system (along with standard creativity index), after using the visual mnemonics devices, thus demonstrating a case for integrating the visual mnemonic devices among methods to foster creativity.

Keywords: creativity development methods; visual mnemonic devices; creativity

1. Introduction

Creativity stands alone as the first flame of every accomplishment, by changing the usual mental pattern of information [1,2]. Without creativity, human development would not have been possible. Creativity is a competence that can be improved or affected in time by one's environment and activities practiced. If we seek to improve it, there are many techniques that can be used in different environments and by different types of users in order to enhance creativity. We argue that visual mnemonic devices should be included in that list of techniques.

The most suitable environment in which to use visual mnemonic devices is the school, at any level, including even homeschooling or e-schooling. As any of these environments are based on the educational process, we highlight the three approaches found in literature that aim to blend creativity into the educational process: teaching for the development of learner creativity, creative teaching (creative methods and techniques used in this process), and creative learning (creative learning methods and techniques) [3]. These three approaches to creativity at the educational level are defined by the convergence and subtle differentiation of the proposed objectives. In practice, it is also noted there can be resistance to creative adherence to education [4]. Perhaps one of the biggest problems when it comes to integrating principles of developing creativity at the educational level is the diversity and heterogeneity of the ideas and behaviors they generate [5,6].

1.1. Creativity Developing Techniques

Creativity was enhanced until now in some very different ways. We have tried to collect all the important creativity developing techniques and the conclusion is that the techniques usually focus on creating some internal motivations by activating divergent thinking. Although “Amabile (1983,1988,1996; Amabile & Hennessey, 1987) has found evidence that...extrinsic benefits can undermine intrinsic motivation” [7], creating some extrinsic motivation can be either too expensive or ineffective over a long period.

The creativity developing techniques and the creativity dimensions [5] could sometimes overlap, so the explicit sense can be found in one another. In this sense, it is necessary to specify that the techniques used to develop creativity could be identified with some ways of manifesting creativity, taking into consideration the large usage of the creativity itself. The dimensions of creativity could be identified with exactly those ways of manifesting creativity.

In [8], Smith evaluated 48 creativity techniques (such as morphological analysis, input–output, focused-object, transfer analysis, and bionics) used for idea generation, classified in 15 categories, represented by 48 devices. Three years before in their book [9], Smith, Ward, and Finke published a chapter about the potential of the creative techniques to succeed in problem solving. In his paper, Geschka proposed six techniques to be used for product design issues in organizations to enhance creativity: the morphological matrix, 6/3/5 method, brainwriting pool, card circulating technique, gallery method and collective notebook method [10].

The affective environment polarity also affects creativity, as Bledow [11] and Hirt [12] showed that a positive state affects cognitive flexibility and creativity by offering a feeling of freedom, eliminating constraints and enabling a complete and exploratory style of processing information. By searching the literature, we have found four techniques that are correlated to changes in the affective environment and can perform in the creative field: dark and dim illumination (improves unconscious creativity. It is also shown that an indirect light fosters creativity more than a direct one does [13]), empathy [12], the possibility of promotion [14] and, of course, positive feedback (the good feeling or the hedonistic philosophy enhances creativity by developing courage and self-confidence [12]).

According to Roozenburg and Eekes (1995) and Schlicksupp (1989) [15], creativity techniques are structured into two types, namely the associative and provocative techniques. The principle of classification is based on the type of mental process applied to the preconceived elements; thus, associative techniques combine and bind together elements and provocative ones try to break and modify the given elements. In the literature of [10,16–27] and Osborn cited by [10,28], we have found 22 associative techniques from simple (association and consonance) to complex ones (The Masakazu Nakayam Method and the thinking hats) and 5 provocative ones (e.g., Extrapolation and Khatena Training Method).

In [29] there are 22 techniques, divided into two categories, based on analytical or intuitive thinking. In [30], Miller exposed 10 analytical (linear) techniques and 6 intuitive techniques. Analytical techniques imply the generation of a rational sequence regarding the elements involved, to gain a linear structure and to multiply the rational, linear sequences for a holistic viewpoint. Intuitive techniques are based on a single stimulus and generate a one-time response to that stimulus, usually used as a starting solution [15]. Searching the literature [10,31–37] we have found nine analytical techniques (including the morphological matrix, fragmentation, Ishikawa diagram, and Pareto diagrams) and six intuitive ones (e.g., imagery or expressive activities) [38–43].

In his paper, Tassoul [44] proposed five solution space categories for idea generator techniques. The associative, provocative, and intuitive techniques have the same structural pattern as described in [15,29,30]. In addition to those, Tassoul adds inventorizing and confrontative techniques to the categories mentioned. The inventory techniques are based on gaining all detail or information that surrounds an issue which will materialize into an inventory of ideas, details, or information [44,45]. The confrontative techniques try to break the boundaries of the common elements and offer unexpected solutions to widen the solution space and create new force-fit connections [44,45]. In the literature

of Torrance cited in [46], Crawford cited in [47], Osborn cited by [47], and Allen cited by [47] and [43,44,47–54], we found 4 confrontative techniques (e.g., starbursting and lateral thinking) and 11 inventorizing techniques (e.g., feature listing, checklists, and recursion trees).

1.2. Visual Mnemonic Devices

The word “mnemonic” refers to memory or in correlation to memory. Mnemonic devices are techniques that can be used to encode information for better memorization of the concepts given [55,56].

Mnemonic devices are categorized in different ways. We will focus on the *visual mental imagery* of mnemonic devices [55]. The visual imagery of mnemonic devices implies the imaginary elaboration of the aspects involved. “The imagery has to be of concrete objects or referents of the words, not of words themselves” [57]. The visual mental imagery mnemonic devices involve a mental representation “and the accompanying experience of sensory information without a direct external stimulus” [58]. The devices imply a verbal enumeration, classification, or definition of one concept (or more) and the imagery process of the component objects in their visual perception. “Visual imagery has many of the properties of a spatially parallel system” [57]. The imagery process is using the recall representations from other similar stimuli or a combination of them in order to re-experience the original representation. It is worth mentioning that the imagery is weaker than the original representation, acting as a weak perception [58].

Mnemonic devices were massively studied in the field of their purpose—better memorization of concepts. Visual mental imagery mnemonic devices were studied for the same purpose. Taking into consideration that the devices imply a process of imagery, meaning a group of some creativity fostering techniques (used unconsciously), we shall see that this method can itself foster creativity.

Visual imagery implies that the memorizing process has to be set upon some visual figures that are imagined and associated with the words given. It works especially when the words are concrete (they have a real representation), but it can be used even with abstract words (throw association technique) [59]. The mnemonics must be unusual, out of the ordinary, clear at first view, include at least two objects to have efficiency, and include motion, color, or exaggeration [60]. Lorayne and Lucas (1970) define four rules for an efficient visual mnemonics: substitution, exaggeration, out of proportion, and action [61].

Creating a visual mnemonic device by analogy means that one should imagine some analogical concept with the information that needs to be remembered. By the definition of the analogy, we search to create an abstract parallelism between two concepts from different areas and it can be used in visual mnemonics to find an easy to figuratively represent concept in a different area that is abstractly connected to the main concept, so the easier concept is easily remembered and it can be linked to the main one [48]. Talking about elaboration (Torrance cited in [46]), the process of adding details to information, we observe that it can be used in visual mnemonics [62] by adding details to the main information, more precisely a specific, very important detail, that can be easily remembered by its visual representation and will boost the process of remembering the main information by extrapolating the detail or linking it to the initial information. The combination technique refers to combining different attributes with an apparent unlinked object and may be used when there is a need to remember a list of information presented in various forms [50]. The details of the different concepts may be visually linked, so there is an easier way to remember the visually linked details and to extrapolate to the initial form. Feature listing can be used when there is a need to remember a very important concept that can have visual feature listing (Crawford, cited in [47]). The feature listing will be made visually, so it will be easier to remember and, after that, extrapolated to the initial information.

By the definition of the visual mnemonics [55,58,63] listed above, it is implied that visual mnemonics also take the use of imagery process (the literary process of transposing the information gained from stimulus into literary text), but without an external stimulus. This and the other definitions of the visual mnemonics (the device implies a verbal enumeration, classification or definition of one

concept (or more) and the imagery process of the component objects in their visual perception [57]) imply that the process must rely on the use of analogy, elaboration, combination, or feature listing.

We specified that all the listed techniques can be used to augment creativity and the visual mnemonic devices use only extrapolation or the listed techniques to return to initial information.

2. Materials and Methods

2.1. Overview

Our goal was to verify if mnemonic devices could improve creativity. To achieve our purpose, we tested the subjects before and after the device was applied. We had two groups, a test group and a control group.

2.2. Participants

We targeted two groups, one called the experimental group, who used visual mnemonic devices and the control group, who were not briefed to use visual mnemonic devices. The sampling technique applied was convenience sampling, the groups being from two different classes.

The set was composed of 17 university undergraduates, age 23, and 20 high school undergraduates, adults only. The Torrance creativity tests in figural form were aggregated with the national percentile and score, using the highest age possible (16 years for Romanian score and percentile database).

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki and the protocol was approved by the Ethics Committee of LBU-IRG-2019-05.

2.3. Materials

In order to compare the results of using visual imagery mnemonics on the creativity of the subjects, we chose creativity tests, one given before they used the mnemonic technique and one after. Regarding this aspect, the Torrance figural creativity tests were the most appropriate for observing the imagery mnemonic results, especially because of their figural form, enhanced with drawings and regular and irregular forms [29,53,54]. The reliability of the evaluation method used lies between 0.89 and 0.94, according to TTCT-Figural Manual of 1998 [64].

The visual mnemonic method [63] was used to heighten the following aspects:

- Types of production systems, which the students were familiar with.
- Classification of production systems using the way of processing the inputs in order to obtain the outputs.
- A succession of interior design styles.
- A list of countries classified by GDP.

The words that needed to be memorized were abstract in general, but also included some concrete words (labor, gothic, Victorian, art deco, art nouveau, shaker, eclectic, minimalist, neo-classic, shabby chic, Canada, South Korea, Russia, Spain, Australia, Mexico) [57,65,66], as Paivio's dual code theory assumed that concrete words "elicited more distinct imagery" than abstract words [59,67].

2.4. Procedure

For the experimental group, the form A was applied before using the visual mnemonic devices, and form B was applied after a visual mnemonic exercise. For the control group, the form A was applied before using a classical memorization process (they needed to memorize the same aspects but without further visual mnemonic device explanations), and form B was applied after.

All four exercises were accompanied by directions to develop the visual mnemonics and the usage of a paper was permitted, with the observation that the paper must only include drawings and must be turned to the other side when the evaluation form was addressed. The evaluation form was a form

of evaluating the visual mnemonic method composed of a simple question regarding the memorized information. The directions that were given included the types of visual mnemonics that were possible for the specific case, including shapes, colors, means of hands and fingers, animals, letters, continents, body parts, etc.

The results were analyzed using the comparison of means, standard deviation, and relative standard deviation (as proposed in [68]) of the basic scores obtained, along with the variation of the composed creativity score from form A to form B and a statistical hypothesis test to validate the results. The significance level taken into consideration was the standard 0.05 and the hypothesis test chosen was the two-sample pooled test, mainly because the variances were not equal but under the significance level of failing the test [69].

3. Results

3.1. General Results of the Influence of Visual Mnemonic Method over Creativity

The results, represented in Figure 1, show a growth in the mean standard score, along with the standard creativity index and the percentile rank, from form A to form B. It is important to remember that form A was applied before the visual mnemonics exercises and form B was applied after. The absolute growth of the mean creativity index was nine points, meaning that the techniques that are implied in the usage of visual mnemonics are linked to creativity.

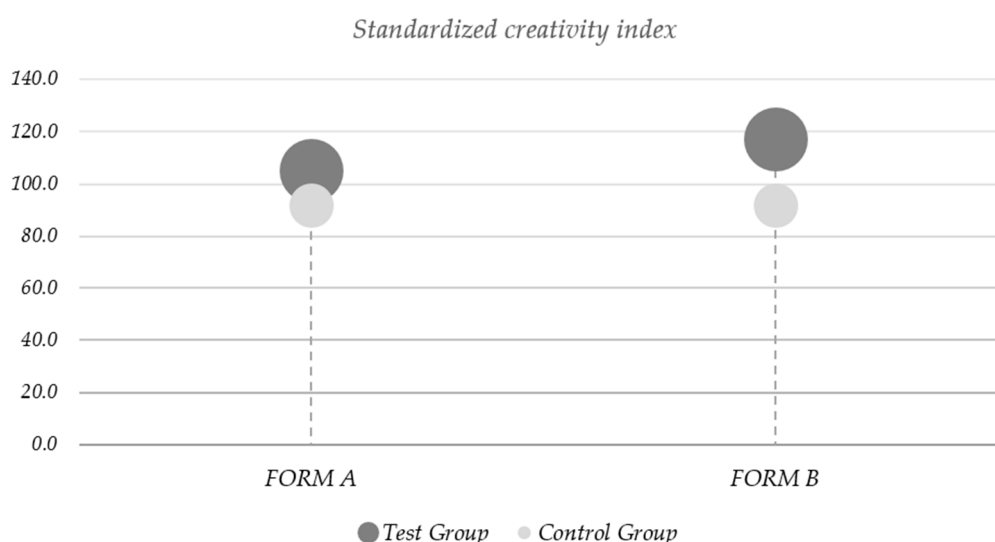


Figure 1. Representation of the mean of standardized creativity index for both groups in form A and B.

Creativity grew with a variance of 12% (see Table 1). Due to the use of the specific mnemonic device technique, creativity was raised 45% in the national percentile system. Next, we will analyze which were the main dimensions that contributed to this variance.

Table 1. Variation of the mean basic scores for each creativity dimension, from form A to form B, for test and control group.

Index	Fluency	Originality	Elaboration	Degree of Abstracting of Titles	Resistance to Premature Close-Up	Mean Standard Score	Bonus Points	Creativity Index
Test group	8%	1%	-13%	15%	24%	8%	41%	12%
Control group	-32%	-9%	-11%	-38%	54%	-2%	40%	0%

Variation of the mean basic scores for each creativity dimension.

3.2. The Five Dimensions of Creativity, before and after Visual Mnemonic Device

The standard creativity score consists of five dimensions of creativity proposed by Torrance and their scores with the percentiles attributed to each one. In Figure 2, standard scores for creativity dimensions, we observe that fluency and the degree of abstracting had the most benefit of using visual mnemonics, but an up going rate exists for all of the five dimensions. Resistance to premature close-up remains on the same level of manifestation among respondents, presumably due to the lack of connectivity between the technique used in visual mnemonics and their power to create motivation, desire to create more, and maintain the active cognitive process. Table 1, variation of the mean basic scores for each creativity dimension, shows that originality stands with a positive variation of 5%, showing that the visual mnemonic devices did not have a big impact on originality, being a tool created for reproduction of the initial information, by creating a visual representation of a settled information. Elaboration grew 5%, from 94 to 98 points in the mean standard score and from 26 to 38 rank on the percentile system, exclusively because elaboration is already a technique that is part of the visual mnemonic device and could be used in the exercise proposed for the respondents. Fluency grew 9%, from 101 to 110 points in the mean standard score and from the 48 to 62 rank in the national percentile system. Fluency was enriched by the analogy and elaboration techniques that were used in the visual mnemonic devices. The two techniques also created new neurological connections between known concepts in order to find a suitable answer for the stimulus (that is the way fluency is measured). The degree of the abstracting of the title grew with the highest variance, 21%, from 67 to 87 rank in the national percentile system, likely since the abstracting of the initial information was the first phase of the visual mnemonic device and it was consciously and extensively used in the process, therefore creating an ease of usage when the form B of Torrance tests were applied.

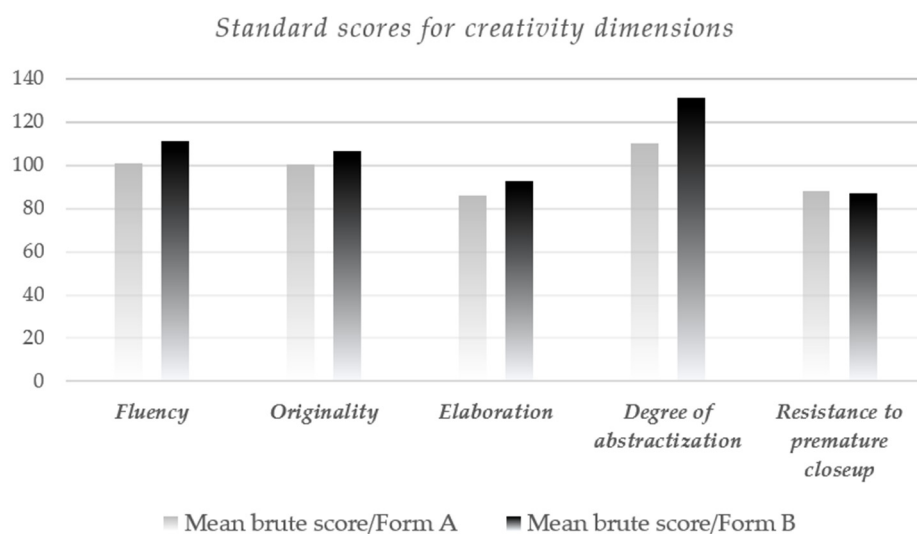


Figure 2. Representation of mean standard scores for each creativity dimension.

The graph below shows the growth of the five dimensions, from form A to form B.

In the following table, we can observe the relative variation of each dimension along with the general results for both groups (mean standard score, bonus points, and standard creativity index among its national percentile rank).

3.3. Overall Results

There is an observable difference between the means of the variations of the two sets of creativity indexes, the experimental group means being 12.16% and the control group being 0.25%. The control group had only a tiny increase in creativity with a stability in time.

The null hypothesis was the zero effect that visual mnemonic devices would have on creativity. The null hypothesis was rejected, thus the *t* stat was 3.81 and the *t* critical two-tail was 2.0322.

The probability of observing a considerable difference in a null state, when visual mnemonic devices were not applied is 0.00055, placed under the significance level of α 0.05. The null value was rejected and there was evidence of difference between the variations of the scores obtained by the experimental group and control group.

4. Discussion

The results successfully validate the hypothesis involved in the study, arguing that visual mnemonic devices had a positive impact on creativity. To the best of our knowledge, there are no empirical studies to show the relationship between visual mnemonic devices and creativity in this direction (the impact of visual mnemonic over creative performance). In contrast, some studies debate the opposite relationship, the impact of creativity on visual mnemonic performance. In [70] and [59], the visual imagery and mnemonics depend on one's creativity, so a good creativity score could improve the performance on visual mnemonic devices.

Although in [71], one mnemonic device designed to help students when they get stuck during a creative process (SCAMPER) is mentioned. It is not a technique that boosts creativity by its mnemonic structure but is based on six different types of mental processes that could be applied to a piece of information to enhance creativity. The book does not mention visual mnemonic devices or other types of mnemonics as creativity techniques.

A review integrated visual mnemonics as a creativity technique based on its structural relation with imagery, and the "intimate" relationship between imagery and creativity. The visual mnemonic technique is presented as a creative method used to boost memory, which is based on imagery and aids to boost creativity through imagery [67]. Our study was focused on the five dimensions of creativity (fluency, originality, elaboration, degree of abstracting of titles and resistance to premature close-up), from which elaboration [67] and originality are the basic dimensions used in the imagery. By definition, the visual mnemonic technique is a device based on the visual imagery [55,57,58,63], imagery has a profound relationship with creativity, enforcing the connection between visual mnemonics and creative performance. Using a rational argument based on the fact that "Visual intelligence increases the effect of human intelligence, extends the creative spirit" (Dondis, cited in [72]), Eriksson states that using visual imagery in education is reasoned on the fact that visual thinking is an important part of the type of intelligence for generating creative ideas [72]. He argues for a holistic curriculum that includes creativity and he underlines visual intelligence as a factor to increase interactivity and diversification of the curriculum. To boost creativity, he proposes visual imagery as a within reach tool.

In [73], Brade stated that interactive mnemonic visualizations are suitable for managing creative works, involving highly complex data, without restricting creativity regarding a creative task. He specifies that the interactive mnemonic visualizations are to be structured as a map, containing connected information surrounding an issue, so the creativity being reinforced by flexibility and complexity of the data could be achieved by the proposed device. In [74], Brown proposed a visual mnemonic device (Loci's method) as a creative technique used to enhance memorization in the educational process. The technique's purpose is to enforce memorization, but Brown considered it a creativity technique due to its connection with imagery. The correlation between creativity and visualization underlines that "successful creating seems to depend on the degree to which mental images can be manipulated" [62]. The visualization process includes mental synthesis of sensory experiences, transformed into mental images. In the visual mnemonic devices, the visualization process is exactly the principle process used in order to gain the mnemonic needed [55,57,58,63], thus influencing immediate creativity, as shown in our study.

A study, presented during a conference focused on critical thinking, showed that visual imagery had positive implications in critical and creative thinking [75]. Similarly, Durio marks up the relationship between the two of them by the degree of imagery used in creative functioning [76]. Moreover, the first

study implied the relationship between visual mnemonic performance and critical thinking test scores and interpretation. The results show that visual mnemonic performance was directly proportionate to the critical and creative thinking and scores. Although, it was shown that the mnemonic device was not helpful with students having difficulties with visual imagery, the advantage of using imagery was maintaining a “relaxed receptiveness to the review of information” and a “lessening of anxiety in approaching the midterm as the information was ‘owned’ by the learner” [75].

The present study confirmed the hypothesis considered; the visual mnemonic devices were able to boost creativity, as the results showed different means by the variations of the creativity tests before and after (12.16 for the experimental and 0.25 for the control group). Due to the profound connection to creativity and imagery [67], the visual mnemonic devices seemed to affect creative performance.

Limitations of the study involved the circumstance sampling technique and a relatively small sample (17, 20) for each group, due to limited resources. That interfered with the hypothesis testing but was validated due to a normal distribution and a small difference between variances [69]. The measurements of the level of imagery and internal visualization were not taken into consideration when observing the effect that visual mnemonic devices had on creativity, but were appreciated as average (due to direct observation and drawings of the internal visualization realized by participants through the experiment).

5. Conclusions

The creativity domain is always expanding, like creativity itself, from any point of view. The present study concluded that there were effects of the visual mnemonic devices on creative performance, thus supporting the initial hypothesis that visual mnemonic devices would be able to enhance creativity. Through the primary research that was performed, it was shown that creativity increased with 45% in a national percentile system (corresponding to 12% in standard creativity index) after using the visual mnemonic devices, supporting the case that the visual mnemonic devices should be considered a technique that fosters creativity. The present study extended the literature in the creativity field by adding a new creativity technique to the ones already established. A visual mnemonic device is a technique that can be used in any type of environment and circumstance, being also extremely suitable for educational purposes, promoting creativity in the curricula adaptations in practice. Future studies may focus on investigating visual mnemonic devices’ effect on creativity on bigger samples of groups or choosing a different sampling technique. They may also focus on studying the influence of the other mnemonic devices on creativity or critical thinking.

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