

Development of selective attention through play in higher education students

Desarrollo de la atención selectiva a través del juego en estudiantes de educación superior

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Abstract

The research is focused on the application of the “DIMAPA” Games, which are a set of dynamic, entertaining, motivating and guided activities, based on drawings, mandalas and words designed for the General and Applied Histology and Embryology course; being the main objective of the work to develop the selective attention of the students of Dentistry. This is an applied type investigation, with an explanatory level, an experimental study with a quasi-experimental design and a quantitative approach. The sample of the experimental group consisted of 13 students and the control by 11, on which the attention test d2 was applied; after which the “DIMAPA” games were applied to the experimental group in 30 learning sessions, distributed over 4 per week. After the intervention, the d2 attention test was applied again to our two formed groups and the data obtained was processed. In the analysis and interpretation of the results, it was shown that, according to the Student’s t test, the students to whom the “DIMAPA”, games were applied significantly increased the development of their selective attention, according to the three parameters evaluated (effectiveness total: $p = 0.034$, concentration: $p = 0.023$ and variation: $p = 0.048$), therefore we conclude that the games “DIMAPA” develop selective attention; For this reason, the proposed alternative hypothesis is accepted rejecting the null ($p < 0.05$).

Keywords: “DIMAPA” Games, Selective Attention and Learning.

Resumen

La investigación está enfocada en la aplicación de los Juegos “DIMAPA” que son un conjunto de actividades dinámicas, entretenidas, motivadoras y pautadas, basadas en dibujos, mandálas y palabras, diseñadas para el curso de Histología y Embriología General y Aplicada. El objetivo del artículo es desarrollar la atención selectiva de los estudiantes de Odontología. El método de investigación es de tipo aplicada, con un nivel explicativo, con diseño cuasi-experimental. La muestra del grupo experimental esta constituida por 13 estudiantes y el de control por 11, sobre los cuales se aplicó el test de atención d2; luego, al grupo experimental se le aplicaron los juegos “DIMAPA” en 30 sesiones de aprendizaje, distribuidas en 4 por semana. Culminada la intervención se procedió a aplicar nuevamente el test de atención d2 a los dos grupos conformados y se procedió al procesamiento de los datos obtenidos. En el análisis e interpretación de los resultados se demuestra que, según la prueba estadística t de Student, los estudiantes a quienes se les aplicó los juegos “DIMAPA”, aumentaron significativamente el desarrollo de su atención selectiva, de acuerdo a los tres parámetros evaluados (efectividad total: $p=0.034$, concentración: $p=0.023$ y variación: $p=0.048$). Se concluye que los juegos “DIMAPA” desarrollan la atención selectiva.

Palabras clave: Juegos “DIMAPA”, Atención Selectiva y Aprendizaje.

Introduction

Selective attention is basically a mental function that processes part of an information, i.e. it discriminates the interest of the stimulus. This indicates that the process of selection of stimuli is linked to attention, so that when a stimulus is selected for some reason, it will be the one that passes the filter of our attention.

The study carried out during the theoretical-practical activities developed in the classroom could show that one of the problems affecting university students is related to the selective attention difficulties because they tend to be easily distracted, not allowing them to concentrate on specific tasks, thus creating difficulties in the knowledge assimilation and thus in meaningful learning.

Selective attention gains great importance at the academic level (Stevens and Bavelier, 2012, p. 30). Whatever the education level, attention plays a determining role in academic performance. Thus young university students with attention problems can have a very low academic performance - among other consequences (Barragán, et al. 2007, p.23). Leading the student to academic failure has become a serious concern for higher education institutions (Khan, et al. 2013, p.80). Thus the common challenge in the educational field is to reduce this failure (Cid-Sillero, et al. 2020, p.60).

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About the arguments defined, selective attention is a tool to be able to interpret and select the available information. In our case, it is in the educational activity that it sets in motion and controls all the processes and mechanisms by which the organism processes only a part of all the information and responds only to those environmental demands that are useful or of great importance for the student.

In the neuroeducation field, executive functions have gained special interest in recent years because their relationship with academic performance has been demonstrated (Véglia and González, 2018, p.28). These functions coordinate the activity of higher mental functions, such as attention, and within their modalities we find selective attention, which requires greater cognitive effort. Indeed, executive functions and attention are essential to carry out successfully any learning (Portellano, 2019, p.112).

It is inferred that selective attention is the ability to focus the mind on a specific stimulus or task, despite other environmental stimuli, and this is where the university student should give preference to certain stimuli able to attend the most relevant and inhibit distractors.

Besides, it is also one of the main concerns of higher education to determine at what point of cognitive processing the action of the selective process occurs in the student. Our subconscious works continuously, without being noticed, discarding automatically all those stimuli considered unimportant.

In relation to the topic, the importance of neuroscience in the educational context should be highlighted, because they allow us to know in a scientific way our brain activity (Cherrier, et al. 2020). And as part of neurosciences, neuroeducation is specifically concerned with studying the optimization of the teaching process - learning based on the functioning of the brain and the neurobiological foundations that support it (Gago-Galvagno and Elgier, 2018, p. 40). Neuroeducation contributes to the innovation and transformation of education and its pedagogical practice, in help of neurodidactics and its methodological strategies to facilitate the learning of the students in order to achieve an education for life (Falconi, et al. 2017, p. 61).

This is the reason for the study to promote game as a strategy to see the selective attention process directly with university students. With the importance of executive functions in learning and therefore in academic performance, it is necessary to implement educational helpful strategies to stimulate these functions. (Véglia y González, 2018, p. 30).

Therefore, game and/or playful techniques in this research become mediators to develop selective attention that would improve learning for university students, through pleasant experiences in order to achieve competences and abilities for the understanding of theoretical concepts in the academic field.

This is why the concern to implement game as a strategy arises, like the "DIMAPA" games to develop the selective attention that is a superior mental function. These games act at the same

time as mediators in the teaching learning processes achieving to university students a better understanding of concepts, categories and theories, thus optimizing their academic performance.

The research objective is to determine the influence of game on the development of selective attention for dental medicine students in a Private University of Arequipa, to improve the learning and assimilation of theoretical knowledge.

Theoretical framework

Selective attention

According to Introzzi et al. (2019), selective attention is “a cognitive function that directs attention to an object or stimulus that is relevant, avoiding distraction to those that are irrelevant” (p. 106).

This means that selective attention allows a person to select and focus on something in particular for further processing, while at the same time it cancels irrelevant or distracting information, this ability to concentrate on the task and to ignore distraction seems to have relevant effects in several important domains to academic foundations, (Stevens and Bavelier, 2012, p. 33).

Then selective attention helps to improve cognitive performance, it improves learning experiences and filters useful information: “Selective attention and executive functions are a combination of mental skills that allow us to solve new situations and problems that we do not have prior knowledge of” (Portellano, 2019, p.110).

These functions coordinate the activity of higher mental functions such as attention. Indeed, the executive functions and attention form an inseparable and indispensable pairing to carry out successfully any learning and without its correct functioning it would be very difficult to obtain an adequate adaptive behavior.

Continuing with the topic, Portellano (2019) distinguishes two kinds of attention according to the complexity degree: involuntary and voluntary or executive. The latter refers in a very special way to the attention modalities that require a greater cognitive effort, where we find the selective attention, defining it as the ability to maintain

a certain response to a stimulus despite the presence of other distracting stimuli that compete simultaneously with each other, allowing to pay attention to relevant stimuli, excluding others.

Therefore selective attention is the activity that executes and controls all the processes by which the mind selects information, where the time of concentration depends on the interest generated by the task and the difficulty of the task.

Cid, et al., (2020) consider that, among the executive functions, attention deserves a special consideration because it represents the fundamental basis on which all learning rests. For this reason, the student’s attention seems to have a direct influence on their academic performance, i.e. those with better executive performance obtain usually better grades (Jiménez, et al. 2019, p. 215). Rojas y Rincón (2015). It is also the ability to select, among several possibilities, the most relevant information because selective attention processes only part of an information (p.44).

It is inferred that selective attention is more frequently used but not all people achieve adequate concentration. This skill is learned and strategies must be implemented for the efficient use of higher mental functions and cognitive processes.

Game as a playful technique

Throughout history, game and learning have been closely linked. A lot of theories and schools start from game as the ideal basis for learning. From ancient times to the present day game is present throughout man life (Calvo and Gómez, 2018, p. 25).

Huizinga (1972), one of the most important theorists of the game, considers that we need permanently the game for life because it gives us joy and motivation. Game experience provides also an integral enrichment of the human being.

For this author, the playful side is in human nature, it forms a deep and spontaneous part of the emotional life of man. Then, under this approach the aim is the development of higher mental functions such as attention through game.

De la Cruz, et al. (2020), highlights also the power of the games and that playing can be as serious as

living, even if it is lived as a game. Playing reveals players' character and what they have in mind. Vergara (2017) considers as well the game as an exercise for life and a natural educational agent.

It is a tool that is part not only in childrens' life but also in the adult one, game is part of daily life, it is considered as a way to entertain, to have fun, to de-stress, to learn, among others (Montero, 2017, p. 77). It benefits the maintenance of the cognitive and functional state of the elderly people, facilitating meaningful learning and social interaction (Souza, et al. 2016, p.155).

Likewise, Girgin (2017) considers that no matter the age to play and that those who spend their time playing are ahead of those who do not. Besides, he proposes to create laboratories of games and toys in schools and universities, to open game development courses in education universities and postgraduate programs so that aspiring teachers can take courses to develop games. Thus game is considered as a fundamental factor in the people development as individual and social construction, stimulating physical-motor development, allowing social interaction, stimulating values, attitudes and norms necessary for social harmony (Mendieta, et al. 2019, p.15).

The benefits of game-based learning are well justified in literature but there are not enough studies on its applications in different disciplines in higher education. However, empirical results support the effectiveness of game in higher education and they show also that students enjoy this way of learning. (Mas-Machuca, et al. 2019, p. 57).

Game is an essential tool in teaching practice to promote learning. The implementation of playful strategies in the university context constitutes an innovative and enjoyable method of teaching by providing better learning experiences, because it arouses the students' interest and invites them to reflect and to use creativity in the formulation of possible solutions to problems (Marles, et al. 2018, p.50).

Likewise for Flores (2016), the importance of selective attention development through game is linked to the challenge and intense activity of learning to be able to generate better results in the knowledge acquisition in the education field (p.

190). Like it is described in the Gargallo games (2000), cognitive stimulation optimizes attention. The present research is focused through the application of games, inspired by the educational intervention program. These "DIMAPA" games are a combination of dynamic, entertaining, motivating and guided activities, based on drawings, mandalas and words, designed in relation to the course of histology and embryology of Dentistry career.

Methodology

The research method is a scientific one. For Bunge (1976), "The scientific method is a procedure for dealing with a combination of problems, where each of them requires a combination of special methods and techniques" (p.24), so the problem is formulated with precision about the observed reality and the existing theory, proposing well-defined and well-founded assumptions, and the hypothesis is subjected to hard, not lax, contrast, and inquires because the result is as it is. The level of research is applied, for Arias (2012) it is necessary to answer why certain phenomena occur and what is the cause. The central questions of this level of study are: what and why these events or phenomena occur. There are two characteristics of study: the observation and the experimental side. Applied research was used and according to Baena (2017) it is necessary to know a concrete reality of social problems so as to modify or generate knowledge, addressing the relationship process between theory and results. The research corresponds to the quantitative approach that is a combination of sequential and evidentiary processes. This experimental research has a quasi-experimental design. For Hernández et al. (2014), in the quasi-experimental design the subjects are not randomly assigned to the groups or paired, but they are already formed before the experiment. They are two groups with similar characteristics: in the experimental group the intervention is performed, in the control it is not. However, both groups are bound pre and postponing.

The census population consisted of all students of the second semester of Dentistry, enrolled in the course of Histology and General and Applied Embryology, from which a non-probabilistic sample was obtained consisting of 10 women and 3 men for a total of 13 students for the experimental group and of 11 people, all women for the control group to whom the pretest and posttest are applied.

Participants' ages of both groups range from 17 to 18 years, so we can affirm that age and sex in both groups are evenly distributed, not influencing these characteristics in the final results. The technique used was the direct observation. The study was carried out entirely in the practice laboratory. At the beginning of the semester, the study measuring instrument was applied in approximately 10 minutes, using the d2 attention test. This is a letter cancellation test, which determines the ability to pay attention to a stimulus or a fact, while it cancels distracting letters (Gall et al. 2018, p. 17). Therefore, it measures selective attention associated with sustained attention and it is applied from 8 years old on (Cedeño and Loor, 2019, p.35).

The "DIMAPA" games are applied in 30 learning sessions, distributed in 4 per week. In each of them, the student was given the respective indications, norms and/or rules of the game (which contribute with the understanding and proper development of each game session), later the development of the activity in the time determined according to each session, then the evaluation of the activities was carried out (attached in a monitoring sheet). After the sessions, the attention test d2 was applied again and the data obtained was processed, using the classic version of the test (pencil and paper). With the numerical data collected, we obtain the three dimensions of the d2 test corresponding to our dependent variable. We refer to:

- Total effectiveness (TOT). This is the main measure for the validation of the d2 test and the most used in experimental and applied studies; providing a measure of attentional and inhibitory control and relationship between the speed and accuracy of the subjects.
- Concentration index (CON). This score is very reliable and provides an index of the balance between speed and accuracy in the performance of subjects.

- Index of variation or difference (VAR). The VAR score evaluates the stability and consistency across time of the subject's performance. Therefore it is important to note that an extremely high VAR score may suggest an inconsistency in the subject's work.

Following the Brickenkamp's theory (2009). Total effectiveness scores (TOT) and concentration index (CON) are directly interpreted, that is: higher the score is, the student's attention capacity is more important. On the contrary, with the index scores of (VAR) a low score is better than a very high score because it can suggest a weakness in the subject's work. Knowing that the minimum values of the three dimensions is 0 and maximum value for total effectiveness (TOT) is 658, concentration (CON) is 299 and variation (VAR) is 47.

For the statistical analysis, the parametric test t of Student was used, whose purpose is to compare two arithmetic means, being in our study the pretest and posttest, between the study groups.

This research was developed in 2018 with the object of study to improve selective attention through the "DIMAPA" games in dental medicine students of a Private University in the city of Arequipa.

Results

The effectiveness of the "DIMAPA" games was verified by comparing the scores of the students of the control and experimental groups in two moments: before and after the administration of the program applied to the experimental group. For the statistical analysis, the Student T test was used, considering the statistical significance of the values below 0.05, as for the pretest and posttest as the contrast between the two study groups (control and experimental). The results were:

Table 1.
Comparison of pre-test selective attention between the Control and Experimental Group.

	Selective Attention Pretest Measuring	Research Group	
		Control	Experimental
Total Effectiveness	Arithmetic Mean	413.91	470.15
	Minimum Value	306	314
	Maximum Value	593	569
	P	0.117 ($P \geq 0.05$) N.S.	
Concentration	Arithmetic Mean	154.00	173.00
	Minimum Value	88	71
	Maximum Value	259	240
	P	0.338 ($P \geq 0.05$) N.S.	
Variation	Arithmetic Mean	19.64	18.62
	Minimum Value	9	8
	Maximum Value	43	33
	P	0.769 ($P \geq 0.05$) N.S.	
	Total	11	13

Matrix of data collected.

According to table 1, with respect to the pretest selective attention among the control and experimental groups, we can be observed that the students of the control group obtained a score of 413.91 (in terms of total effectiveness), while the students of the experimental group scored 470.15. This difference is not statistically significant. The same thing happens with the concentration, the students of the control group obtained a score of 154 and those of the experimental group 173; from this data it is inferred that the difference of scores is not statistically significant. With respect to the

variation, and as it is better a lower the score, the students of the control group scored 19.64 and the students of the experimental group scored 18.62. Even if the students of the experimental group scored better, the difference is not statistically significant (Table 1).

We conclude that the control group and the experimental one start with the same conditions in the three evaluated dimensions before the application of the program of the “DIMAPA” games.

Table 2.
Comparison of post-test selective attention between the Control and Experimental Group.

	Selective Attention Post-test Measuring	Research Group	
		Control	Experimental
Total Effectiveness	Arithmetic Mean	479.00	533.23
	Minimum Value	380	382
	Maximum Value	652	641
	P	0.034 ($P < 0.05$) S.S.	
Concentration	Arithmetic Mean	177.91	212.46
	Minimum Value	70	156
	Maximum Value	293	283
	P	0.023 ($P < 0.05$) S.S.	
Variation	Arithmetic Mean	16.00	13.62
	Minimum Value	1	2
	Maximum Value	26	28
	P	0.048 ($P < 0.05$) S.S.	
	Total	11	13

Matrix of data collected.

According to table 2, regarding the comparison of posttest selective attention between the control and experimental groups, the students of the control group obtained a score of 479 (with respect to total effectiveness), while the students of the experimental group scored 533.23. This difference in scores is statistically significant.

With respect to concentration, the students of the control group obtained a score of 177.91 and those of the experimental group 212.46, this difference in scores is statistically significant.

Regarding the variation, the students of the control group obtained a score of 16 and those of the experimental group 13.62, this difference is statistically significant.

We conclude that, at the end of the study, the experimental group obtained a decrease in variation and higher scores in both total effectiveness and concentration with respect to the control group. The difference is statistically significant, i.e. the use of "DIMAPA" games allows to increase the total effectiveness and concentration and therefore to develop the selective attention.

The results are similar to the Del Toro's ones, et al. (2016). They conclude that the implementation of different recreational activities managed to increase the selective attention of the students.

Discussion

In relation to the hypothesis, the results demonstrated the efficacy of the "DIMAPA" games to develop selective attention for the dental medicine students with attentional problems.

The recreational activities designed for learning of Histology and Embryology subjects managed to develop significantly selective attention by increasing its total effectiveness after the evaluation of the "d2" test: TOT 0.034 ($P < 0.05$) S.S. and raising its concentration level: CON 0.023 ($P < 0.05$) S.S.. In the same way the index of variation had a substantial variation: VAR 0.048 ($P < 0.05$) S.S.. In the results found in the experimental group, according to the arithmetic mean, the difference between the pretest (479.00) and posttest (533.23), the former one with the highest level.

We can affirm that the game improves the selective attention of the dental medicine students with the

results obtained from the d2 test thanks to the comparison between the pretest and posttest as we can see in tables 1 and 2. We can interpret that before applying the "DIMAPA" games in the pretest, they do not show significant differences. However, in the posttest there are significant differences between the control and experimental groups after the execution of playful activities.

These activities were evaluated with the d2 test. According to Brickenkamp (2009). The test that measured these results is the d2 one and belongs to the category of tools to measure the basic processes required to succeed in complex tasks. These processes have been denominated with the terms like attention, mental concentration, effort or attentional control. Therefore, this evaluation tool is a concise measure of selective attention and mental concentration. As described in the d2 test manual, it alludes to a selection of stimuli focused continuously on a result.

From the results obtained, it is inferred that the students of the experimental group, during the application of the program of activities with the "DIMAPA" games, skills had been developing that make up the competition to attend, such as: a) The speed or the amount of work, which is represented by the number of stimuli that have been processed in a given time (motivational aspect or intensity of attention). b) The quality of work, which is given by the degree of precision (attention control aspect), and c) The relationship between speed and accuracy, which allows to obtain conclusions on the behavior, the degree of activity, the stability and the consistency, the fatigue and the effectiveness of attentional inhibition.

The present research based on the results allows us to establish comparisons with other studies, such as the research conducted by Lemus (2016) who made an effectiveness study about a program on children's attention of 6th grade of primary education in a Guatemalan institution. The sample took into account 20 students of both sexes among 11-12 year olds, with a middle socioeconomic level. To measure selective attention the Brickenkamp d2 test was used. In a creative way, the designer applied the "attentive" program, whose the purpose was to improve selective attention. In the results analysis, he compared the average with the statistical test of T of Student through the Excel program. Concluding that the students of the research increased significantly their selective

attention level due to the effects of the “attentive” program.

There is another research like Joao’s one (2010) which applied the educational intervention program to increase attention and reflexivity PIAAR-R in 37 children between 10 and 12 years old with attention deficit, high impulsivity and hyperactivity. As he did not find significant effects on attention and reflexivity, he indicated that these results could be related to the evaluation measures of the program, time factors (frequency and rhythm of sessions), inherent factors to the technician (lack of intervention quality control strategies), the appearance of parasitic variables such as the appearance of social influence phenomena, aspects that concern external observers/evaluators and aspects related to the theoretical basis of the program.

Finally, the improvement of selective attention of the experimental group, statistically demonstrated, is due to the effectiveness of the “DIMAPA” games that develop selective attention in dental medicine students. This research can be seen as a contribution to further studies about attention.

Conclusions

The results showed that the application of the “DIMAPA” games has a favourable and significant influence on the selective attention development among the students in the experimental group. These games act also as mediators in the learning teaching processes, achieving in the students a better understanding of theoretical concepts, thus optimizing their competences in the academic field.

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