# Methodology for the evaluation of the levels of attention and meditation in the development of virtual online classes of mathematics, through the use of brain-computer interface

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**Abstract:** Online classes are causing many changes, from the behavior of students to the way they are understanding the classes. In a normal situation, students are in school classrooms, where the environment is suitable for students to pay the most attention, in these times, where online classes are developed, classes are developed at home, where they were adapted environments to carry out these activities, in these situations they cause the appearance of distracting agents, causing students to be distracted when they are in class, these distracting agents can be the same house, the toys, the television and in some cases the brother who is in classes and found in the same environment. The proposed methodology proposes the analysis of the environment where the online classes are held, in a particular case, with the use of the BCI device, measurements of concentration and meditation levels are carried out, on a scale from 0% to 100 %, measurements are carried out in various conventional situations that are carried out in class, with the intention of being able to determine the best strategies so that students can have the best concentration when taking mathematics classes; The results determine that in a conventional situation the student has a concentration level of 20%, which indicates that he is not very attentive to the classes, but when we try to eliminate most of the distracting agents and concentrating on the class, we achieve a level of attention that reaches 90 "with minimum values of meditation, which indicates that the students can achieve better concentration in the classes, in order to take advantage of the class and solve math problems, we finished the work recommending the best conditions that They must be presented in order to present high levels of attention when taking online classes.

**Keywords:** Attention, meditation, online classes, BCI, math.

## 1. Introduction

The pandemic that COVID-19 is producing is causing many changes in people's activities, with much more emphasis on activities related to education, at all levels. School education is being the most effected, because classes today take place in home environments, causing the presence of many distracting agents such as toys, television, parents, siblings who also they are in their online classes among other factors. The measurement of brain activity is one of the mechanisms by which the behavior of the human being can be known, in these measurement processes the equipment based on Brain Computer Interface (BCI), help in the measurement and in the interpretation of the different signals produced by the human brain. Making a review of the literature, we can find works related to measurements related to evaluating the levels of concentration and meditation when children are playing video games, in order to know how much they concentrate on this activity that is very common today. "(Auccahuasi et al., 2019). Knowing the brain behavior in each of the activities carried out by the man is having importance, we also find works in knowing the behavior of brain activity when the person is performing rehabilitation exercises with the intention of knowing if he is collaborating in his process of rehabilitation (Auccahuasi et al., 2019).

Disability is one of the factors that is studied a lot, in most cases it is related to brain problems, which is why the use of BCI devices is relevant (Battistin et al., 2020). Technologies, as well as helping in development, are causing certain problems, among them video games are causing certain problems related to their dependence (Bonfiglio et al., 2019). The educational processes are being studied frequently with the intention of being able to know their impact on the students, therefore the BCI devices are fulfilling an important task (Burgos, 2020). In the neurolearning process, the BCI devices are fulfilling a fundamental task in the registration and analysis of the different brain signals such as the types of signals known as Alga, beta and Gamma (Chae, 2020) (Daza et al., 2020). Knowing the use of BCI devices is of vital importance, to be able to exploit them in different applications, as there are many varieties of devices, knowing their technical characteristics is important to be able to take advantage of them (Crawford et al., 2019). The relationship of students with parents is a very common subject of study, in these times of pandemic this relationship is being very affected because they are sharing much more time together and generating new reactions, which are the object of study, in all levels (Dong et al., 2020) (Eyimaya et al., 2020). Virtual reality is testing many applications, trying to demonstrate its application mainly in the field of education, there are many initiatives trying to show that its characteristics can be used, to demonstrate its applicability, the use of BCI plays an important role, such as For example, measuring brain

behavior (Gang et al., 2018) (Hernandez-Cuevas et al., 2020). In the study of brain behavior, neurons play an important role, being able to understand their behavior is important, in this role BCI devices play a role in this task (Naufel et al., 2020) (Pillette et al., 2019 ).

At this time all kinds of educational processes are carried out remotely or more commonly called online, based on these needs, the use of technology is gaining importance because thanks to it this purpose is achieved, it should be mentioned that depending on the conditions , means and resources, are being used and exploited in order to improve educational indicators (Peñuelas et al., 2020) (Pombo et al., 2020) (Qazi et al., 2020) (Wlodarczyk et al., 2020). Understanding how children learn and in this process knowing how the brain learns, is very important because we can relate the level of learning with brain behavior, in this way we can identify if the learning mechanisms are causing changes in brain behavior, In this task, BCI devices play an important role because it is thanks to them that brain behavior can be measured through the monitoring of brain waves (Spüler et al., 2017). These models of how the brain learns is not only applied to beginning-level students, but is also being carried out in higher-level students, mainly dedicated to students of health careers (Yang et al., 2020). Finally we can indicate this effect of being in quarantine at home, carrying out all activities such as educational, work, among others, they are causing many changes in the behavior of people's behavior, psychological health is being very important for this reason. They are using BCI devices in order to measure these psychological behaviors related mainly to measuring pressure and stress levels (Yeasmin et al., 2020). In the present work the levels of concentration and meditation in students are studied when they carry out their classes online, using BCI devices, with the intention of being able to know the degree of concentration at the time of the classes, mainly the mathematics course and to be able to recommend certain Actions to improve so that students can better concentrate on the development of virtual classes.

## 2. Materials and Methods

The methodology that is presented is related to being able to analyze situations that the student is developing at the time of taking the online classes, below we present three necessary steps used to evaluate the methodology, developing each of the stages. Figure 1 shows the block diagram of the methodology.


Figure 1. Description of the methodology

### 2.1. Class setting specifications

The first stage is dedicated to evaluating the environment where the online classes take place, in most cases, the environment where the online classes take place is a home environment; The room is the one used, in it we can find the television, radio and other objects that we commonly find in the room, these objects can cause the students to be distracted, in figure 2 you can see a particular situation of an online class that It will be the object of this study. The image shows a 16-year-old student and his 6-year-old brother. The measurements will be made to the 16-year-old student, because in their math classes they present a greater complexity in the calculation and their need to be concentrated.

In figure 2, you can see the environment where the online classes take place, as can be seen in the images, one of the distracting agents is the brother who is also in the online classes, as well as in this case, At home there are many distracting agents that are directly or indirectly causing distractions in students.

### 2.2. BCI device configuration

Information and communication technologies are causing the possibilities of measuring certain signals of the human body, which years ago were difficult to record, currently we find electronic devices that can perform a number of tasks, capable of registering and analyzing signals related to the human body, as we can indicate cardiac signals, signals of muscular behavior, signals of brain activity among others. In our case, it is necessary to register the brain signal and to be able to present the value of the level of attention and meditation that the person is presenting at that moment.

In figure 3. The equipment called BCI, mindwaere model is presented, which has the particularity of recording the brain signal through a sensor placed on the patient's forehead, the equipment presents a headband to be able to couple the device in the head of the pupils.

**Figure 3.** Mindwave model BCI device used in the research

The device connects with the computer through the Bluetooth communication port, with this connection the data is sent directly to the computer to be able to record the values through an application that records the levels of attention and meditation. Figure 4 shows the connection modes that allow identifying if the equipment is connected.


**Figure 4.** Device application to analyze the connection with the computer.

**2.3. Analysis of common situations in math classes**

In this third stage of the methodology, the measurements of the results obtained with the device and a description of what may be happening in each of the situations that have been the object of measurements are presented..

In order to be able to analyze, we can indicate that the level of attention is the mechanism by which a person is paying attention and is focused on the actions that they are taking. In the case of the level of meditation we can indicate that it is the moment when the person is thinking about an action that does not require being concentrated, such as listening to music or being relaxed.

**Primer caso:** The first case that this reference was analyzed when the student is not doing some activity, so the measurements of the level of attention and meditation are in the range of 19%, which may indicate that the student does not pay attention to the activities that you are doing, being able to be a daily activity that does not require much attention from the student.

In figure 5, you can see the measurements of the levels of attention and meditation in the student when he is doing a daily activity, the values of attention and meditation are low for this reason.

**Second case:** In the development of the second case, the levels of attention and meditation will be analyzed, when the student is attending his classes online, as can be seen in figure 2, where the student is in his class as well as being influenced by his brother who is also doing his class, the level of attention he presents is in the

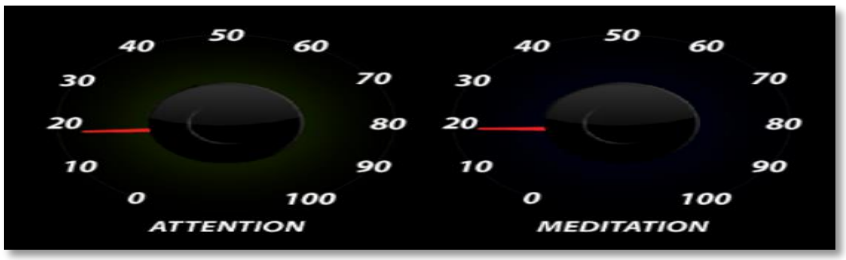


**Figure 5.** Levels of attention and meditation when the student is performing a daily action.

range of 70% and the level of meditation at a level of 80%, which indicates that the student is paying attention to the class, but is also distracted . As can be seen in figure 6

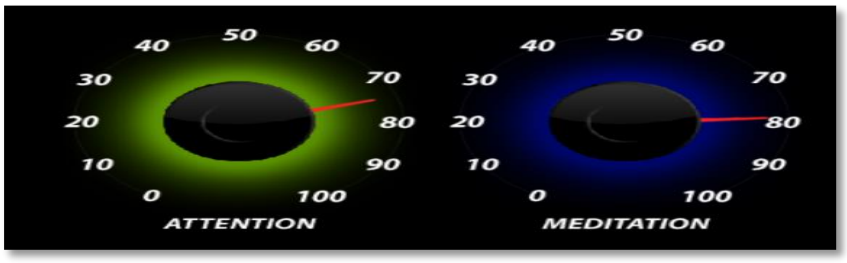


**Figure 6.** Levels of attention and meditation when the student is doing his class online.

**Third case :** The third case is very important, because it tries to demonstrate the applicability of the methodology, in this case we proceed to place the BCI device on the student, as well as tell him to concentrate on the activity to be carried out, trying to concentrate only on the classes, in figure 7, we can identify the student in the concentration process.

**Figure 7.** Preparation for the final evaluation of the student.

In figure 8 you can see the student performing a mathematical calculation task, in which he has to perform calculations and record the results in an Excel file, this mathematics task, the student has a limited time to be able to present it, which allows evaluation, the student is concentrated and is the ideal time to record the levels of concentration and meditation.

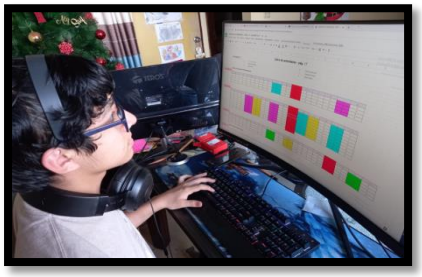

**Figure 8.** Realization of the online
math class with the BCI device.

In figure 9, the results of the third case are presented, where the student is concentrated in carrying out the mathematics tasks, performing calculations and completing in an Excel sheet, a characteristic of this activity is

the limited time that has to carry out the activity. The level of attention that is achieved is the high value close to 90% which indicates that the student is attentive and concentrated on the task, the value of the level of meditation is the lowest with measurements close to 10% which indicates that the student is paying attention to the classes and their respective activities.

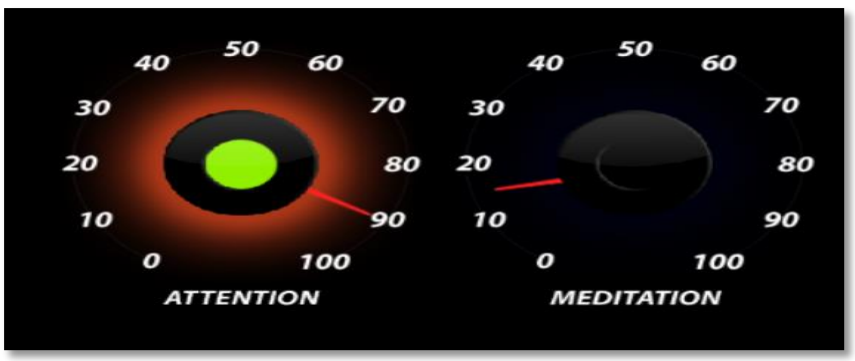


**Figure 9.** Results of the final evaluation of the student, demonstrating the methodology.

**3. Results**

At the end of the investigation, the results obtained in the measurements made to the 16-year-old student, we can mention the following results depending on the cases presented:

- For the first case, where the student is not doing any specific activity, the values of attention and meditation are in the average of 20% for both cases, these results show that in a daily action, where people do it every day, the activities are carried out without paying much attention, demonstrated by the values recorded with the BCI device.
- For the second case, where the realization of a mathematics class is evaluated in a classroom environment and in everyday conditions, it presents a level of attention of 73% on average with a meditation value of 80%. These values are obtained after taking the measurement by instructing the student to act as if he were in a class every day. Although the value of attention is important with 80%, which indicates that the student is attending the class, he also encounters a daily situation that affects his attention, these situations are considered as distracting agents, in this case due to More than being attentive and concerned in his math class, he is distracted by the distracting agents, which is why he also has an 80% level of meditation, because he is thinking about what activities his brother is doing or in his classes, we can also indicate that you are thinking about your brother and what activities you are doing.
- For the third case, the student was conditioned in the areas to be carried out, trying to eliminate all types of distracting agents, conditioning a larger monitor in such a way that his field of vision could be focused on the school areas. The results show that by eliminating the distracting agents, the level of attention increases considerably, reaching values close to 90% as a result of the concentration that the student is having in math classes and activities. The mathematics course is considered the most important, dedicating more attention and time to it by the students. The measurements also show a considerable decrease in the level of meditation reaching minimum values on average of 15%, which shows that by concentrating on their classes, all kinds of distractions present in the environment where the classes take place are eliminated..

**4. Conclusions**

It is concluded at the end of the investigation, that the human brain is complex and for this reason it is subject to many influences that are in the environment, these influences are those that are constantly presented through the senses, being able to register visual influence, mainly sound influence , these two manifestations tend to cause distractions in students when taking online classes, which are held at home.

In conducting online classes, in these times of quarantine, these distracting agents will always be present, measurements made at three different times show that these distracting agents can be eliminated by trying to condition the environment and talking with the student in which can focus on their activities and responsibilities.

The measurements made in the mathematics course serve to show the importance of the course, because the student, no matter how distracted he is, is always concerned in the course trying to be attentive and maintain this attention for as long as possible, the mathematics course will be one of the main courses that require more attention, therefore the concern of the present study in being able to know the levels of attention and meditation in the realization of an online class.

The experience carried out can be applied in students of other ages and other courses, as well as supplemented with certain activities and other characteristics of the brain, trying to study the different behaviors that generate the influence of the environment, and how these influence the activities carried out by the people with an emphasis on educational processes. The use of BCI devices that provide us with technology, allow us to integrate multiple functionalities that were previously difficult to record and much less analyze, these devices allow us to record and subsequent analysis of brain signals trying to interpret the values recorded with actions that people are doing.

Finally we can indicate that in the realization of mathematics classes the students show the highest degrees of attention, due to the importance of the course, in the learning process and because of the importance of being able to learn in addition to the need to attend the teacher in an online class, because at the end of the class there is no way that any consultation can be made to the teacher, thus limiting the teacher-student relationship, the levels of attention can be improved by eliminating or attenuating the distracting agents in the environment where they are carried out online classes.

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