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SCHOOL ACTIVITIES THAT EMPLOY ICT AS A RESOURCE TO FACILITATE LEARNING IN A STUDENT WITH ADHD

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Abstract:-
This work presents the results of a case study in which professionals work in collaboration to help a student with attention deficit with hyperactivity disorder (ADHD) learn physics. Two kinds of activities were 1espect1: activities that include simulations and traditional ones. The attention span of the student in both kinds of activities was compared; in activities that include simulations this span was longer and the disruptive actions were less frequent. Due to this information, the use of simulations in physics learning activities oriented to students with ADHD proves revealing.

Key words:-*Attention deficit with or without hyperactivity (ADHD), ICT, school adaptations, physics.*

Highlights:-
- *The work in collaboration of various professionals (researchers, teachers, educational psychologists, psychologists) and the family of the student is necessary to plan school interventions and adaptations for students with ADHD.*
- *The integration of technology in activities can help the learning process of students with attention deficit with hyperactivity.*
- *It is found that the attention span of a student with ADHD increased and his disruptive actions were less frequent.*

1. INTRODUCTION

This work shows the advancements in a research whose objective is to help students with attention disorder with hyperactivity (ADHD) learn physics with Information and Communication Technologies (ICT.) In the hope of contributing to the design of proper environments for the students' learning experience, didactic strategies that teachers can make use of in their classes with students with attention difficulties are proposed.

A work in collaboration that covers different areas of expertise to pay attention to the learning difficulties of a student with ADHD is proposed. A case study was conducted which revealed that the activities designed with integration of PHET simulations help the student with ADHD to focus his attention on a task and to decrease the number of disruptions, compared to pencil-and-paper activities (traditional activities.)

2. Background Information

The teaching and learning of physics for students with attention deficit is an innovative topic in educational research, especially considering the possibility of using ICT.

2.1 Characteristics of the disorder

Attention deficit disorder (ADD) is mainly characterized by difficulties in 2espect2r2l aspects. The subjects are easily distracted by external stimuli, as a consequence, they have difficulties in listening and following instructions, focusing, keeping their attention and resisting distractions. In a school environment, this leads to difficulties in concentrating and applying themselves to specific tasks, therefore, their work is erratic and disorganized. Subjects with ADD are not skilled in studying and find it difficult to work independently (Barkley, 1998 y 2009; APA, 2000.)

ADHD is characterized by a diagnostic triad that consists of attention deficit, hyperactivity and impulsiveness; some of these symptoms being more salient than the others (Abadi y Pallia, 2007.) In addition to the characteristics of the attention deficit, the subjects develop an inappropriate and increased motor activity compared to children of similar age, sex and socioeconomic status; for example, the subjects are constantly moving in the classroom (they may shake in the chair, toy with an object or wander around the place.) The impulsivity is related to the impossibility of restraining their 2espect2r and reacting; they cannot control themselves. They have verbal outbursts, talk in excess, meddle, involve themselves in dangerous activities, answer questions before they are finished and have difficulties with transitions and changes of activities. Furthermore, subjects with ADHD are socially immature, have low self-esteem and experience great frustration (Rief, 1999.)

Bauermeister (2014) states that people with this disorder did not ask to be like this. However, he argues that this is not an excuse for their 2espect2r, as they can be taught to auto regulate their conduct and achieve self-control with the collaboration and commitment of their families, teachers, educational psychologists and fellow students. In one of his researches, Bauermeister claims that 12%-18% of children between 6 and 11 years old with attention deficit failed a school year. Polanczyk et al. (2007) estimate that the worldwide prevalence of ADHD is
5.29%, this disorder prevails in youth in 65%-75% of cases (Wilens, Faraone y Biederman, 2004.)

A bibliographic revision on the incorporation of technologies to help students with ADHD learn science was conducted (Author, 2016.) It is therefore concluded that the majority of the consulted works show:

- The classroom, didactic and socioemotional configurations students with ADHD should be provided with.
- The advantages of integrating educational technologies as a resource to help students with ADHD in the learning process.

We assume that involving students with attention deficit in learning situations that include carefully selected simulations contemplating difficulties such as motivation and partial reinforcements as they solve the task can increase the attention span they spend solving an activity. This increment, in turn, favors the chances of completing the activity, therefore promoting a possible evolution in learning. Therefore, as a consequence of the bibliographic analysis already mentioned, this research can be summarized in a question: how can we help students diagnosed with ADHD to learn physics by using ICT?

According to the results found in the bibliographic revision work, technologies could permit students:

- Focusing attention from different sensory channels: visual, auditory, tactile.
- Interacting with the models provided by the simulation.
- Performing an action and starting again if so required (because they notice an error, they want to change values; they want to corroborate an idea.)
- Increasing or decreasing the difficulty of the task, etc.

3. Theoretical framework

This research is in line with the constructivist paradigm; we assume that the subjects, in this case students, are the constructors of their knowledge. Stating that students construct their own knowledge does not mean that they are inventors nor discoverers, rather, they are responsible for this construction process and this depends on their own mental activity; teachers cannot do it for them. Subjects make a personal construction that cannot be dissociated from the context it takes place in and the experiences that they participate in; therefore its social and shared nature. In this context, the teacher's duty is to plan the class; this means selecting and sequencing contents, proposing situations by which students can achieve the learning goals, evaluating situations, managing available resources, fostering interaction between students and between students and the teacher. The objective is to negotiate and renegotiate meanings.

3.1 Designing Activities with ICT for Students with Attention Disorders

Some researches point out that the use of technologies can be helpful for the learning process of students with ADHD (Rief, 1999; Desch, 2000; González Rus y Oliver Franco, 2002; Geurts, Luman e Van Meel, 2008; Kang and Zentall, 2009; Fabio and Antonietti, 2012; Lewis y Brown, 2012; Bolic, Lidstrom, Thelin, Kjllberg & Hemmingsson, 2013; Vassilopoulou and Mavrikaki, 2016; Lewansdowski, Wood y Miller, 2016.)

Simulations make possible to interact and adjust the complexity of the tasks; that is to say, they permit to modify parameters, to add or subtract variables and to alter velocities and sizes of stimuli. The modality of presentation with image, sound and the access to parameter manipulation are significant factors in the design of activities that integrate this kind of technology. For the aforementioned reasons, integrating these simulations to the designs permit students to access different levels of complexity, to avoid frustration in their attempts, to correct their answers and to receive feedback.

There are three works that stand out when designing activities that include simulations: the one by González Rus y Oliver Franco (2002), as it points out the prerequisites technologies need to 3espec; the work by Fabio y Antonietti (2012,) who claim that hypermedia tools can have a positive effect in the retention of three types of knowledge –descriptive, conceptual and procedural-; and the work by Lewis y Brown (2012,) who point out the importance of understanding how people with ADHD process multimedia information in order to design the task.

4. Methodology

When planning school approaches for students with ADHD it is important to consider a collaborative and interdisciplinary team work. Authors such as Abad Más, Ruiz-Andrés, Moreno-Madrid, Herrero y Suay (2013) state that the academic performance of students with attention deficit is affected by alterations in the attention mechanisms and in the processes of inhibitory control. Therefore, these authors claim that it is necessary to design psychopedagogical interventions that include the family, the students, the school and a multimodal treatment. In the same vein, Bauermeister (2014) remarks the need to form work teams that include the family and the school, as this kind of interaction would be an important factor in the success these students can attain. Moreover, this author expresses the need of carrying out school adaptations, which implies modifying the practices and usual procedures addressed to these students' needs. It is for these reasons that this research work is presented bearing in mind the importance of the concordance and collaboration between several participants: family, school (head teacher, teachers, educational psychologists and other staff members) and researchers in sciences teaching and learning.

This research assumes that the collaborative work of several specialists is a methodological strategy to understand and get involved in teaching and learning processes. The research team is in contact with several schools of the city, so it communicated with them to ask which would be willing to carry out a collaborative work. An educational guidance team was required, as well as teachers and families willing to participate in this work with the researchers and students with psycho-pedagogical reports stating the disorder. Finally, the team found an institution that fulfilled all these requirements. The psycho-pedagogical report of a student from this institution indicated that the student had learning difficulties, dyslexia and some degree of hyperactivity and attention deficit disorder (ADHD.)

A case study was conducted which, according to Stake (2007), is called *Instrumental*, as the case serves as an instrument to study a topic "in depth."This research examines the cognitive residues that could result from working with learning activities that include educational technologies. Additionally, focus group interviews were conducted aiming to discuss the use of the technology that was presented in physics classes. The aim of using this technique instead of individual interviews was that the student diagnosed with the disorder would not feel pressured and could answer freely even when surrounded by classmates. An initial question was asked to the student for him to answer first in order to avoid being influenced by his partners' opinions. Prior researches that 3espect the use of ICT in biology classes (Vassilopoulou y Mavrikaki, 2016) have revealed promising results using this technique.

4.1 The Case

The consulted works of Abadi y Tripicchio (2015) highlight the need of 3espect3r learning in its natural environment. Considering these recommendations, and after meeting the educational psychologist from the institution the subject attends, it was agreed that the case needed to be studied in a classroom context, as this makes possible for the student to perform in situations as he usually does while not being studied. The classroom is a space in which students work, at times, individually and, in other moments, with others, who can be peers or the teacher. This space is affected by both external noises (for instance, noises coming from the corridors or the schoolyards) and the internal noises that result from sharing physical spaces with other people (students talking and/or leaving their seats, movement of desks and chairs, the teacher walking around the classroom, etc.)

The due permissions of the student's parents were solicited. For a period of three months during 2015, the researcher conducted observations of the physics classes of the 4th year group the student with the disorder attended. The aim was to know the work dynamics of the teacher with the students, that is; the kind of activities that took place, the resources that were used, the criteria of content selection and sequencing, ways of evaluating, etc. Additionally, the main objective of the observation work was to know the social functioning of the student with attention deficit and hyperactivity, that is, his interaction with his peers and the teacher. During the whole year 2016 there was a participation in one out of two weekly classes of physics of 5th high school year (the physics teacher is the same both for 4th and 5th year.)Activities that included simulations and activities that included pencil-and-paper-only were held during five months.

4.2 Technological and Communicational Infrastructure

The institution has technology that enables to connect computer equipment such as Wi-Fi, but neither this nor the virtual platform of the school are used by students; therefore, they do not have a personal account to link to the institution when working with netbooks or cell phones. There is neither any use of networks (such as social networks) to communicate with the teachers. For these reasons, the activities that are carried out preserve some traditional characteristics; when activities that integrate technology are proposed (simulations), paper is used to record the answers. Contents such as tasks, their answers and evaluations will be recorded by means of a structure such as a virtual platform that links teacher and students when personal accounts are available.

4.3 Teamwork

The educational psychologist of the institution, the physics teacher and the researcher worked intensely to develop activities that included simulations and pencil-and-paper-only activities. The answers of the activities that included simulations were also recorded in paper because the teacher, at the end of the class, took them for evaluation.

It is worth noting that there are not simulations for every topic and that not all technologies available are useful towards the achievement of all learning goals proposed by the teacher. The implementation of an activity that includes technology involves the analysis of three aspects:

- The contents. This aspect implies the alternative ideas or preconceptions of students in connection with their previous knowledge.
- The learning goals proposed by the teacher.
- The simulations: the peculiarities and possibilities (advantages and disadvantages) they offer in relation to: a) conceptual and procedural contents and b) adaptability conditions for students with ADHD.

By 4espect4r these dimensions, activities that include simulations and pencil-and-paper (traditional) activities were planned. In both cases, the content involved in them was not modified; that is to say, activities with simulations and pencil-and-paper activities were designed for the same topic. This process was carried out for five topics and, for this reason; there are five registers of each kind of activity. In a class, traditional activities were solved and then, in a different class, students worked with activities that included simulations.

At the moment of planning the activities with simulations, the recommendations of González Rus y Oliver Franco (2002) were taken into account. These authors suggest that technologies should include:

- Some ludic activity: that is to say, they should provide the possibility of creating something, solving a problem, achieving a specific goal, etc.
- A grade of difficulty accessible for the student's knowledge.

However, these authors claim that technologies should not include an excessive amount of animations. If technologies include too many attention points, they can become an obstacle rather than being beneficial, as the difficulty for the student lies in focusing his attention, therefore, this kind of experience can be frustrating for him. Here is an image, Figure 1, of Hockey eléctrico, a simulation used for the topic charges and electric fields.

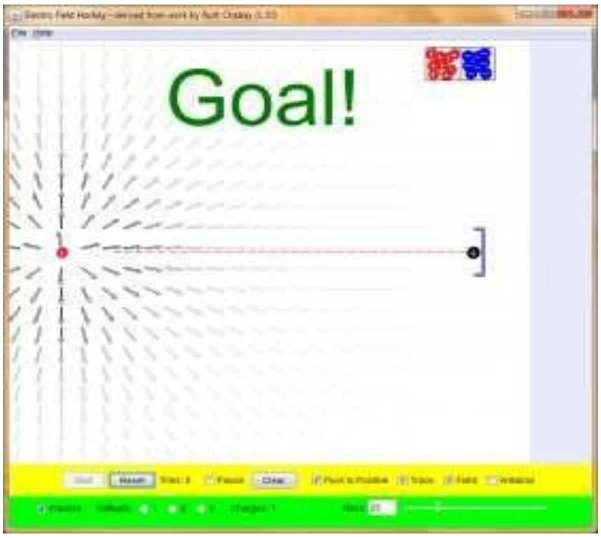

Figure 1. Hocley eléctrico

Another recommendation the work team bore in mind was presenting tasks sequentially to avoid overstimulation. According to Tokuhama-Espinosa (2011) sustained attention lasts between 10 and 20 minutes, therefore, the activities were designed to be solved in that amount of time, including the time to interact with the simulation and the time to answer the questions. The same was done for the pencil-and-paper activities. The choice of activities usually depended on what the teacher aimed to achieve, the topic to be developed and the possibilities offered by the simulation. In some opportunities the activities were developed in a period of time 5 minutes shorter or longer than expected

5. Registers and Analysis

5.1 Symptoms Register Forms

A set of adapted forms by Sá Guimarães, de Carvalho y da Costa (2007) were used to obtain registers that could help the team in aiding a student with ADHD learn physics by using ICT. These forms were suited to the specific characteristics of this case study and the aim of this work. These authors make use of four forms that cover different aspects: Time and Calculations, User's Acceptance of the Technology, Motivation for Technology and Symptoms' Manifestation.

Form I, Time and Calculations, was considered at the beginning of our research work but was later excluded, the reason being that our aim was not knowing the amount of correct or incorrect calculations made by a student. The team considered the use of ICT in general and of simulations in particular to help students with ADHD learn by increasing the time span they pay attention to a task and by guiding them to solve tasks autonomically.

Furthermore, we joined Motivation and Acceptance in a single form, as we considered that we could integrate how attracted the student was by the simulation with his acceptance of this resource. Therefore, based on the original four forms, two forms were used in our work:

- Form I:User's Technology Motivation and Acceptance
- Form II: Symptoms' Manifestation

The categories covered by them were modified according to the team's goals. The form Symptoms' Manifestation keeps the authors' original categories, although rearranged in subitems as expressed in the following paragraphs.

The characteristics of the implemented versions of the forms are highlighted below.

Form I: Technology Motivation and Acceptance The aim of this form is to represent the commitment to the proposed activity of the student being 5espect5. The identification of motivation and acceptance stems from a subjective appraisal, as it is carried out by the researcher as an observer who fills in the form based on knowing how the student acts in other situations. In this form, *yes* or *no* were used to answer each item.

Form II: Symptoms' Manifestation The aim of this register is to identify the occurrence of certain symptoms of ADHD. It consists of two main subitems: *attention shifts to make a comment/consult others* (partners, noises, etc.) and *intense physical 5espect5r*. To make use of this form it was necessary to consider the appearance frequency of certain symptoms and the duration of some of them. For this reason, in order to overcome the restriction of time measurement by means of a clock and the register of frequency of actions, we worked together with the research team *Base de Datos y Procedimientos de Señales* .This group made the register process possible by designing an app that can easily be installed in a laptop or tablet. The app allows the researcher to access a section in which nine buttons represent *events* and *states*. In *events* we recorded data such as: comments that were irrelevant to the task, the number of times the student calls the teacher and the number of times the student consults his partners. In *states* we recorded situations that lasted for an extended period of time, the register enabled us to measure the amount of time expressions of restlessness (moving in the chair or in other place, toying with an object, etc.) or impulsiveness (repeatedly clicking the mouse, inability to control verbal outbursts, etc.) lasted. Two categories, Other 1 and Other 2, were added to each subitem to record a non-considered event or state.

We have registers of classes about physics topics; five of these classes included activities with simulations and the other five pencil-and-paper-only activities. Recording through the software allowed us to obtain the ratio of realization of the *events* and the time span of *states*. It should be kept in mind that states and events are related to Form II, which is focused on symptoms' manifestation.

In the following sections we comment on the analysis that was carried out for events and states (in connection with Form II.)Later, we present an analysis based on the data of Form I and on focus group interviews.

5.2 Analysis of Events and States

The aim of this analysis is to identify the time during which the subject is paying attention to the activity. This includes:

- The total duration of the activity.
- The appearance frequency of events.
- The periods of time in which the student is in a given state.
- The average number of appearances of events according to the total amount of time that the activity lasted.

5.2.1 In Connection to Events

By way of example, table 1 reflects the data related to events gathered from pencil-and-paperonly activity.

Table 1: Example of registers of events for a pencil-and-paper-only class activity

Events –actions-	Frequency
Addresses partners	4
Addresses the teacher	34
Utters irrelevant comments during the experience	42
Total	80
Amount of time the subject spends solving the activity	25:17

In the aforementioned example the amount of events (frequency) pertaining to *attention shifts to make comments/ consult others* totals 80.Therefore, the student performed a disruptive action every 0.32 minutes; or we can say that the subject remains 0.32 minutes without performing an action (time without action.)

The aforementioned analysis was carried out for each of the five registered classes, both for pencil-and-paper-only activities as well as for those that include simulations, resulting in ten tables as the previous one.

Another moment of the analysis is presented in table 2; in it, the results, per class, of the events are presented and the periods of time without action, both for activities that include simulations and for pencil-and-paper-only activities, are compared.
Below, Table 2 is presented together with a comment on the results.

Table 2: Summary of the results of periods of time without action per class

Class	Pencil-andpaper-only activity	Activity that included simulations
A)	0,32	0,68
B)	0,46	1,32
C)	0,45	1,30
D)	0,98	0,63
E)	0,78	1,04

For instance, in class B the period of time in which the subject does not perform an action rises from 0.46 minutes, for the paper and pencil activity, to 1.32 for the activity that includes simulations. This represents an improvement of his time without performing actions of almost 287%, which could be considered time that is used to focus on the activity.

If the periods of time without performing disruptive actions are compared, we can observe that in two classes (B and C) the period of time between actions almost triples, in another (class A) it doubles and in another one (class E) it improves in 33%.

In class D, the period of time between actions is 35% shorter in the class that includes simulations compared to the one that only includes pencil-and-paper activities; therefore, the student intervenes more frequently. Next, we will introduce comments on this register that differs from previous results. The activity designed to include simulations demanded for the
first task:

1) *With the available elements build an electric circuit that is open and can then be closed*.
Considering this, questions such as the following were asked:
a) Does the lamp turn on? How would you explain this by applying the concepts that were worked with in class?
b) Measure the voltage or electrical potential difference between two points with a voltmeter. Explain if you find any differences.
c) Is there any change in the circuit's performance if several batteries are added? Which are those changes? How would you explain them based on the knowledge you have constructed in previous classes?

Initially, the student could not build the proper configuration to make the lamp turn on. On the screen, there appeared an image of a circuit on fire. Other students could properly configure the elements to turn on the lamp; this caused frustration in the student, who became upset, started to move in the chair and to make comments to his partners excessively. We estimate that the activity demanded too much cognitive load from the student. Because of its design, the activity required decision making on several variables, which did not benefit the student's performance.

In Figure 2 we present a graphic that shows the change in the period of time without performing actions or period of time between actions per class for both types of activities.

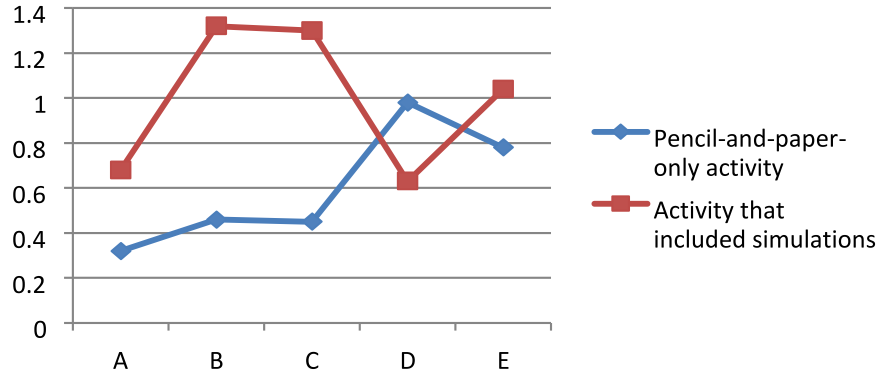

Figure 2. Change in the period of time without performing actions per class for both types of activities

The aforementioned analyses show that when an activity includes simulations the period of time without performing inappropriate actions increases. This could indicate that the inclusion of the simulations may be helping the student to concentrate on the task.

5.2.2 In Connection to States
By way of example, table 3 reflects the data related to states gathered from an activity.

Table 3: Example of the register of states for a pencil-and-paper-only class activity

States	Time (minutes and seconds)
Shows impulsiveness (answers quickly and without thinking, clicks the mouse repeatedly, acts hastily both according or not to the normal course of the game)	0:00:20
Is restless (moves in the chair, shakes an object)	0:01:21
Total	1:41
Amount of time the subject spends solving the activity25:17	

In the previous case the subject spent 25:17 (in minutes and seconds,) that is, 25.28 minutes. Considering the information provided by each table, the periods of time for the registered dimensions were added and a value was obtained, which represents the period of time in which the student was experiencing one of the states associated with *Intense physical 7espect7r*. On Table 3, an example of one of the activities, two of these states are presented; Impulsivity and Restless 7espect7r. In this case the total amount of time of the state is 1:41 (minutes and seconds,) that is, 1.68 minutes. A percentage value was calculated in relation to the time that the activity lasted, and it was found that the state of intense physical 7espect7r corresponds to the 6.64% of the total time considered.

The aforementioned analysis was carried out for each of the five registered classes, both for pencil-and-paper-only activities as well as for those that include simulations, resulting in ten tables as the previous one.

A second moment in the analysis is presented in Table 4, in it, the periods of time in which the subject was restless in both kinds of activity are compared (results per class.)

Below, Table 4 is presented together with a comment on the results.

Table 4: Summary of the results of periods of time in which the subjet was restless per class

Class	Pencil-and paper-only activity	Activity that included simulations
A)	5.58%	1.63%
B)	7.96%	1.57%
C)	1.24%	3.07%
D)	6.64%	17.38%
E)	3.28%	0

In connection with the periods of time that pertain to *states*, it was found that in three of the five classes (A, B and E) the amount of time the subject was restless was reduced in a 49.69% in average in activities that included simulations but increased in the other two (C and D.)

Field notes were consulted in order to expand on the information sources in the analysis of these data. The class in which there was a big increase, class D, coincides with the one mentioned in the previous analysis. This class included an activity that represented an excessive cognitive load for the student as well as a degree of freedom of action that he could not handle. This was negative for the student, and therefore the intense physical 7espect7r category suffered an increment. It was recorded that this period of time corresponded to states of restlessness (the subject moves around in the chair, shakes an object, etc.)

Class C also called our attention, as the period of time in which the subject experiences intense physical 7espect7r increased two and a half times. By consulting our registers again, especially the field notes from that class, we found out that this case corresponded in a 100% to an Other 2.By this dimension of state category, which we had not considered, it was registered that the student kept a pen in his mouth. At this point of our current research we are not able to draw any conclusions about this dimension. However, we understand that keeping a pen in the mouth may suggest restlessness, not in the intense physical 7espect7r sense but rather a, perhaps, cognitive type of restlessness.

Figure 3 shows how the period of time in which the subject is in some state of intense physical 7espect7r changes.

Figure 3. Change in period of time in which the subject is ina state of intense physical 7espect7r for both kinds of activity

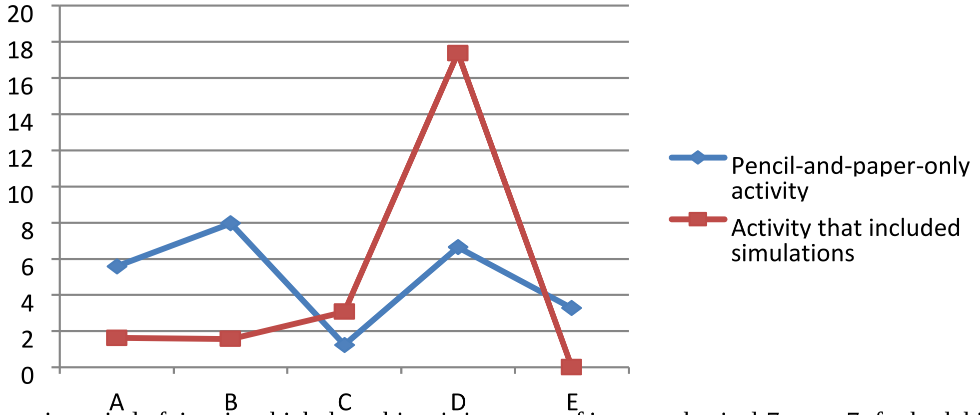

Figure 3. Change in period of time in which the subject is in a state of intense physical 7espect7r for both kinds of activity

The aforementioned analyses show that when an activity includes simulations the period of time in which the subject is restless decreases in more than half of times. This could indicate that the inclusion of the simulation may be helping the student's concentration.

5.3 Focus Group Interview and Results

After one year of study, a focus group interview was carried out and its results were compared to the ones obtained by the application of Form I. On that opportunity it was the researcher who registered the user's motivation for technology, how significant/insignificant it was for the student with the disorder, if he needed external intervention, etc. In the interview the moderator frames the questions and conducts the conversation allowing each of the five students to express, especially the student with attention deficit. In this way, comments and answers of the case study were obtained without exposing the subject to his partners or the researcher. By comparing the results of both procedures, a high level of reliability of results was achieved.

In particular, when asked about their opinion on the use of technology in some physics classes it is noteworthy that for student S (who represents the case) as well as for his partners it was important to vary the kinds of activity that are developed in class.

Student S expressed the following:

S:*It's better, otherwise it's always the same, this way the class varies, sometimes...*Other students interrupted him and expressed their comments in connection with these first ideas: A: *you don't have much of a clue about the topic , about what it could be about, but with this it's different...*V:*I, in particular, don't find it entertaining, but it's good to read it, that is, to work with it this way...*L: *to do something different too, otherwise it's always the same...*

When asked if they had found the simulations "friendly", that is if they had managed to interact with them, one of the students answered: A: *yes sure, it's really easy* and student S adds S: *it's cool, I mean, you can make a mistake* and V:*yes and it's more entertaining too*. This coincides with our records of Form I where we find that in four out of five opportunities he got excited by the use of simulations and he worked answering the task; although he complaint about having to write down in a sheet (he only wanted to interact without recording.)The class in which we did not record a good level of enthusiasm is the one that was previously 8espect8 and presented as class D.

Lastly, when asked about possible advantages and/or disadvantages of the use of simulations in class, S answered: *You see what you learn about theory*. Student L: *They helped me understand better, in every topic in which we used simulations I did better, you put to the test the practical aspect*, and V: *it was cool.* Another student, A, stated the following*: (you see) the theory and what things are for.* We stress that student F commented: *it's cool, but not for all classes.*

It is drawn from the interview and the register from Form I that the student found the class motivating when simulations were used; they allowed him to do something different from the type of activities that he carried out normally. This is relevant taking into account that students with ADHD cannot focus their attention for long periods of time. Variation in activities improves their performance. On the other hand, the use of simulations allowed the student to work on other representation frames and to turn to different channels to work with the content, such as visual and tactile. The student discovered other senses to the concepts developed in physics class, as well as an application for what is discussed in the classroom *(You see what you learn about theory*.)That is to say, the stimuli the student receives are used to help him focus his attention.

6. Final Comments

In the first results a student with ADHD managed to improve the time he spends carrying out an activity without excessive disruptive actions. Furthermore, the student managed to improve his intense physical 8espect8r, which is one the additional symptoms patients with attention deficit experience when they also have hyperactivity. In conclusion, the attention of the student was captured; therefore the student committed more actively to the learning process and made sense of physical contents. It is worth noting that the student sees as important the fact that simulations allow visualization and interactivity as well as the possibility of committing mistakes and trying again. Additionally, the student stated that his performance improved whenever simulations were used.

The integration of simulations in activities requires an analysis that shows its inclusion in connection to specific criteria. Some of these criteria were already mentioned in this text and include: the contents (alternative ideas and previous knowledge), the learning goals proposed by the teacher as well as the simulations: (possibilities, advantages and disadvantages) and a) their relationship to conceptual and procedural contents and b) their adaptability conditions for students with ADHD.

7. Limitations of the Research

During research a case study was conducted, therefore the conclusions we reached may not apply to other cases. More research is needed on how factors such as sleep, tiredness, diet, etc. may have altered the 8espect8r of the case study.

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Appendix A

Form I:Technology Motivation and Acceptance	
Issues	Answers (yes-no)
The user is interested in the use of technology. Makes enthusiastic/complaining comments about technology	
Has difficulties when interacting with the interface	
Has difficulties when interacting with the simulation, requires external help to advance in the use of technology or game	

Modified form from the original version of Sá Guimarães, M.; de Carvalho, L.A y da Costa R.M. (2007)

Appendix B

Form II: Symptoms' Manifestation	
Attention shifts to make a comment/consult others (partners, noises, etc.)	Amount of times
Utters irrelevant comments during the experience (towards his classmates or other focuses)	
Consults his partners to progress in the game	
Consults the teacher (external commentaries) to progress in the game.	
Other 1	
Intense physical behavior.	Time
Is too restless (in the chair or in other place, shakes an object, etc.)	
Shows impulsiveness (answers quickly and without thinking, clicks the mouse repeatedly, acts hastily both according or not to the normal course of the game)	
Changes his physical position (gets up, turns around to talk to a classmate, etc.)	
Other 2	

Modified form from the original version of Sá Guimarães, M.; de Carvalho, L.A y da Costa R.M. (2007)