

# Analysis of computer science newcomers student's motivation

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**Number of pages:**

**Number of figures:**

**Number of tables:**

**Abstract word number:**132

**introduction word number:**304

**discussion word number:**

## Acknowledgments

My thanks to comppet group that lent me a room to make all data collecting and to all 4 volunteers who made the project possible.

**conflicts of interest**<sup>1</sup>

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<sup>1</sup>The authors declare no competing financial interests.

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## 40 1 Abstract

41 Depression and other mind diseases are currently being reported  
42 at universities. Due to it, this research was proposed to observe  
43 a group of newcomers students of the Federal University of  
44 Uberlandia (UFU) along two semesters. Furthermore, resources  
45 provided by BCI (Brain computer interface) technology were  
46 used to collect an amount of data about their emotional state.

47 Data collecting were made on 3 points of semester and each one  
48 was proposed to the volunteers to do same activity related to  
49 computer science course. They executed those activities while  
50 wearing a EEG based equipment, Epoc+, which was responsible  
51 for collecting their emotional data. The results were satisfying,  
52 students became more stressed along time and their excitement  
53 decreased. Surprisingly relaxation has increased, different from  
54 what was expected. The other feelings had no great changes,  
55 though.

56 The results were satisfying, students became more stressed along  
57 time and their excitement decreased. Surprisingly relaxation has  
58 increased, different from what was expected. The other feelings  
59 had no great changes, though.

## 60 2 Significance Statement

61 Mental diseases such as depression, stress, anxiety and other,  
62 had increased in our society nowadays. According to World  
63 health organization (WHO) more than 300 million people of all  
64 ages suffer from the disease, furthermore, as cited in G1 between  
65 2005 and 2015 in Brazil anxiety cases increased 14,9% and the  
66 country is the first one in related cases of the illness on Latin  
67 America, with 5,8% of the population affected.

68 The researcher Michelle Guimarães believes that detecting  
69 mental disorders can be a indicator of mental healthiness on  
70 young students and also she defends that those diseases reduces  
71 students productiveness. Due to it, this paper intend to detect  
72 the mental mood of students using Brain computer interface and

73 appraise changes along time.

### 74 **3 Introduction**

75 Due to the recent increase of mental illness cases in universities,  
76 such as depression, anxiety and other. This paper main goal is  
77 to get a emotional mood change of newcomers university  
78 students along the first two semester of their course. The course  
79 analyzed was computer science in Federal University of  
80 Uberlandia and the data collecting was done while the  
81 volunteers were doing same activities related to the course, for  
82 example programming and mathematics exercises.

83 A brain activity detection can be done by two kind of methods,  
84 invasive and non-invasive. The invasive are base in physical  
85 implants of electrodes for brain waves detection, a non- invasive  
86 involves using, for example, Magnetic resonance or  
87 Electroencephalogram (EEG) to measure brain activities. This  
88 methods detect different waves types, such as, Gamma in  
89 frequency range of 31Hz an up, Beta waves in range of 12 and 30  
90 Hz, Alpha waves ranging from 7.5 to 12 Hz , Theta waves from  
91 3.5 to 7.5Hz and Delta waves frequency from 0.5 to 3.5 Hz. The  
92 Beta and Gamma waves are related to cognition activities and  
93 perception, the Alpha is associated to relaxation and  
94 disengagement, Theta wave is related to stress, frustration and  
95 in the end Delta waves are related to physical defects in the  
96 brain (Larsen, 2011).

97 Researches about identifying emotion based on EEG, technology  
98 used on this paper, are relatively new and many researchers use  
99 beta and alpha waves to do it (Matlovic, 2016). The equipment  
100 used was Emotiv EPOC+, which is EEG based and has support  
101 to same emotional states detection, those are stress, Focus,  
102 engagement, Relaxation, Interest and Excitement, the software  
103 used were Emotiv Xavier control panel (Emotiv Github, 2019)  
104 and the EmotivBCI (Emotiv, 2019). Both makes possible to  
105 calibrate the device to each student and build a percentage  
106 result of it emotion through time.

## 107 4 Materials and Methods

### 108 4.1 Materials

109 The material used was Epoc+ of Emotiv, that can take waves  
110 from 0.16 Hz until 43 Hz(Comparison chart, 2019). As well,  
111 some codes in c language were used during tests.

### 112 4.2 Method

#### 113 4.2.1 Study object

114 The group of volunteers was taken from the newcomers class of  
115 2018-2° semester of Federal University of Uberlandia  
116 Computation Faculty. Due to the difficult of building a  
117 probability sample in a class with around 60 students, it was  
118 opted for a not probability sample. Although, it would not affect  
119 the results of the research, because not probability sample many  
120 times have similar results with probability samples (Manzato,  
121 2012). The 4 students were choosen randomly, being 3 men and  
122 1 woman.

#### 123 4.2.2 Proposed Activities

124 During 2 semesters 5 data collects were made, around 15  
125 minutes each, 2 on the first semester and 3 on the second  
126 semester, it happened because of a problem with internet during  
127 the second data collect of the first semester. The activities  
128 proposed in each one were :

- 129 1. The data was collected using the Software Xavier Control  
130 panel 3.5.1 and annotated handily on Microsoft excel tables.  
131 he proposed activity was a semi-structured interview with  
132 the following questions:  
133 Question 1 - Describe How was your experience and hopes

after enter the first time in the university. Some of that hopes were fulfilled ?

Question 2 - There a lot differences between academic life before and after entering a university. Can you city some of them that happened to you? Which of them affected you the most ?

Question 3 – How your relationship with the professors is?

Question 4 – Many times university is the begin of adult life adding some new responsibilities. Did you have any new responsibilities after entering university ? How do you deal with them ?

Each of these question were made with one goal :

1- Try to persuade the student to feel as he did with his first experiences at university;

2- To influence the volunteer to ponder about how his life has changed and if those changes were good or bad;

3 and 4 – The main goal of it is to persuade the student to think about his new life at university, new relationships and how they feel about it.

2. The Second data collect was not concluded.

3. That data collect was made using 2 software Xavier control panel 3.5.1 and EmotivBCI Both are free distributed by Emotiv. The proposed activity was programming in c language, which is contemplate by first semester grade of the course. A program c was given to them, that program had a syntax problem and they should correct it.

4. This collect was made on the second semester of the research. It, also, was a semi-structured interview with the following questions:

Question 1- Describe how was the experience in the previous semester.

Question 2 – How did you feel returning to university after vacation ? This feeling can on some way influence your future choices ?

Question 3 – How your relationship with professors is ?

171 Compare with the professors on the previous semester. How  
172 do you deal with bad professors ?  
173

174 Each of these questions were made with a goal:

- 175 1 – Try to persuade the student to think about his  
176 experience on the previous semester;  
177 2 – To influence the student to ponder about how his  
178 previous experiences affected his will to study and continue  
179 coming to college;  
180 3 - The main goal is to persuade the student to think about  
181 how his behavior with professors has changed or not.  
182

183 5. The proposed activity was a integral calculus one, They had  
184 15 minutes to solve the following:  
185

1-

$$\int \frac{dx}{\sin^2 3x - 1}$$

2-

$$\int (x^2 + 2x)e^x dx$$

3-

$$\int \frac{\sqrt{a^2 - x^2}}{x^2} dx$$

6. The proposed activity was equal to the 5, only different  
functions were proposed:

1 -

$$\int (\csc x \cot x) dx$$

2-

$$\int_1^2 x \ln x dx$$

186 It is important to notice that integral calculus is taught on  
187 first usemester and they were on their second.

## 188 5 Results

189 The research has shown satisfactory results. As well as expected,  
 190 the students stress increased and excitement values of volunteers  
 191 N1 and N2 reduced along time. The student N3 showed to be a  
 192 outlier, due to it, the results will be divided by calculus counting  
 193 with N3 and not counting with it.

194 Observing each emotion individually it's possible to realize that:

- 195 • Stress: It's one of the most important emotions on this  
 196 paper and it has shown expected results. Furthermore, its  
 197 values raised constantly along data collecting with a  
 198 standard deviation around 33% including student N3 and  
 199 23% without N3 values.

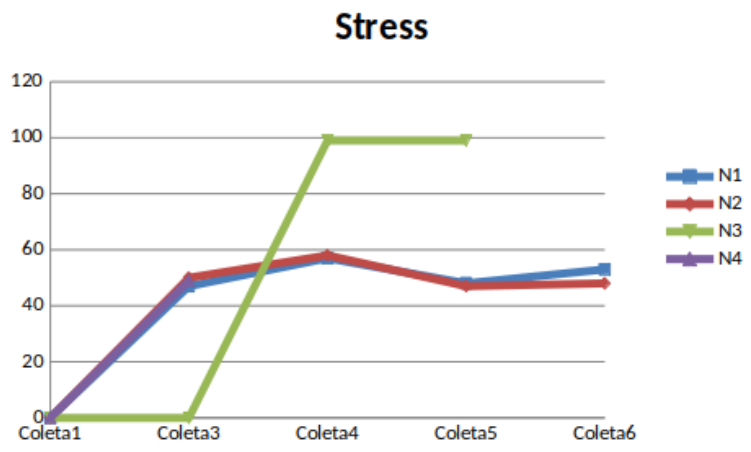


Figure 1: students stress values along data collecting

- 200 • Focus: The Behavior of Focus was different on each  
 201 participant, it presented low values variance from the  
 202 beginning of the research until its end, as it is able to be  
 203 concluded by standard deviation of 11%.



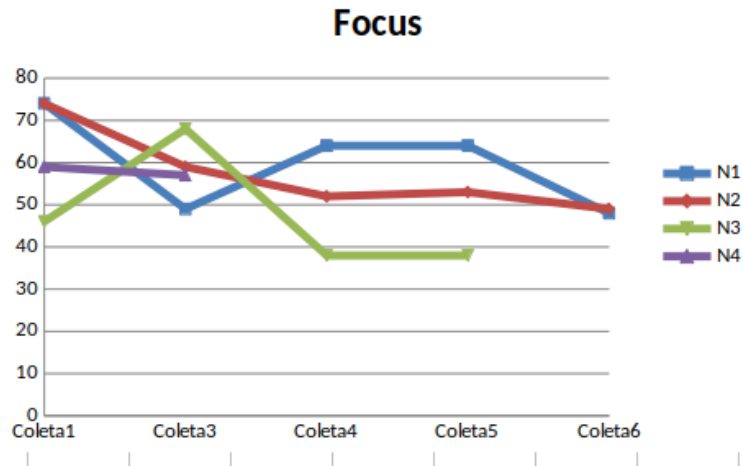


Figure 2: students focus values along data collecting

- Relaxation: Another important emotion to this paper, which has shown controversial feedback, due to constant rise of values along data collecting. The emotion has not shown high differences between students, hence standard deviation of it was approximately 7% without student N3 and around 14% within N3.

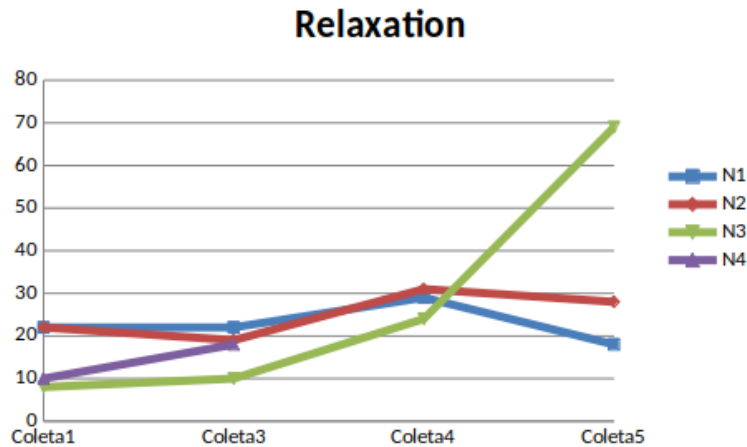


Figure 3: students relaxation values along data collecting

- Interest: Interest behavior was quite the same through all data collects. The values of it had little variances and the

lowest standard deviation of all emotions, under 7% even considering N3 in calculus.

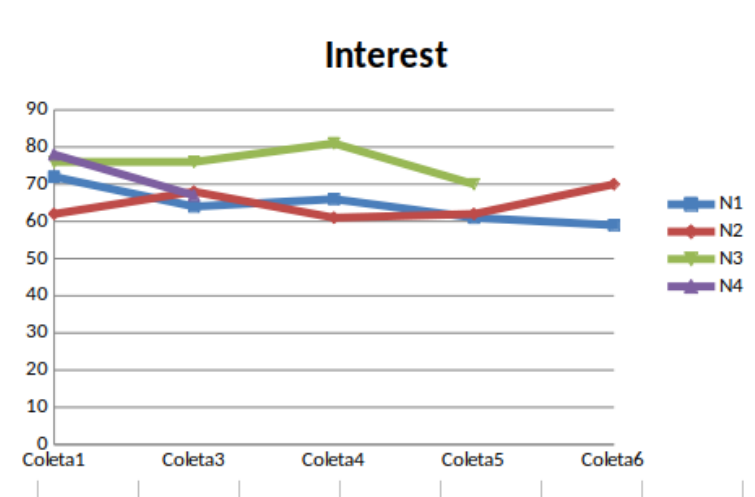


Figure 4: students interest values along data collecting

- Excitement: This feeling presented high alterations on student N3, a big increase from first data collect to last one, it has shown same lower values in mid term collects though. The standard deviation values was around 14% considering participant N3 and 12% without him.

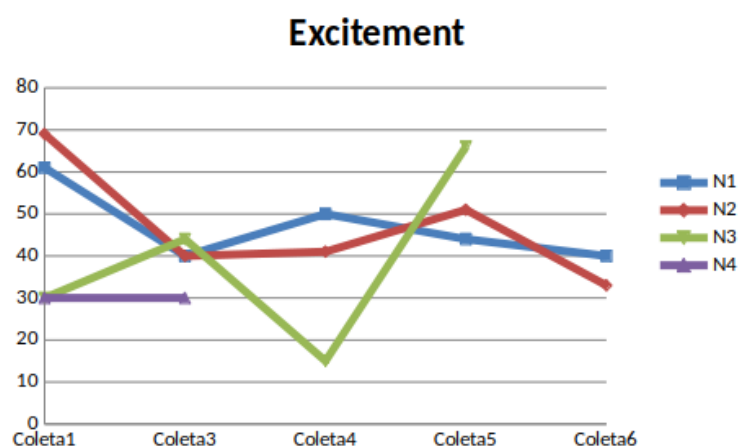


Figure 5: students excitement values along data collecting

- Engagement: Students N2 and N4 presented a high difference from collect 1 to 3, that increase was around 56%. while that, students N1 and N3 did not show significant changes in them values. The general Standard deviation was 21%, however building groups of students with N1 and N2 being first group and N2 and N4 a second, it makes possible to notice that N1 and N3 had no big changes, since standard deviation of the group was 6%. It is not possible to say same of N2 and N4, because their standard deviation was around 30%.

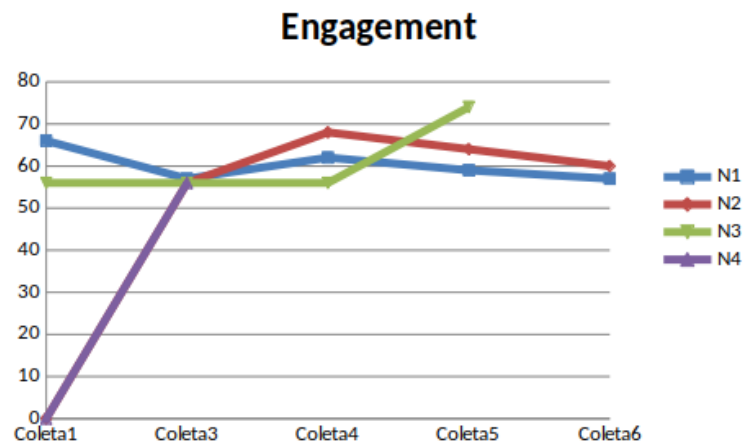


Figure 6: students engagement values along data collecting

## 6 Discussion

Along time it is possible to realize a increase in students values of Relaxation and stress. Excitement, Focus, Interest showed a decrease and Engagement the lowest changes on the same student. It is possible to see the values change by the collecting graphics :

- Collect 1 : Only one made with all four volunteers.

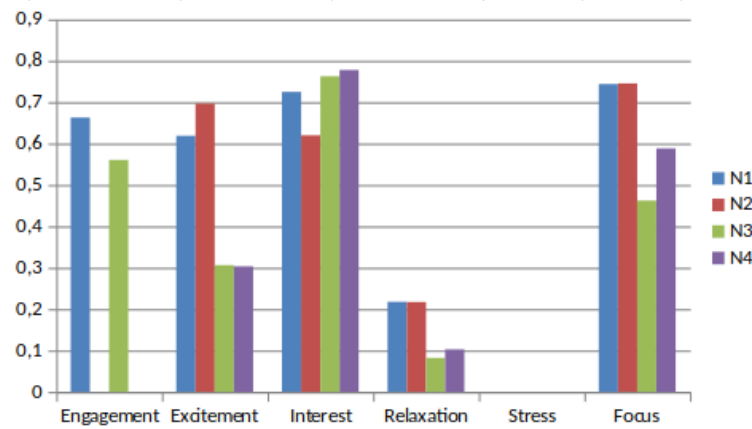


Figure 7: Coleta 1 results

- Collect 2: That Collect data was lost due to a internet problem during the test.
- Collect 3: participants N1, N2 and N3.

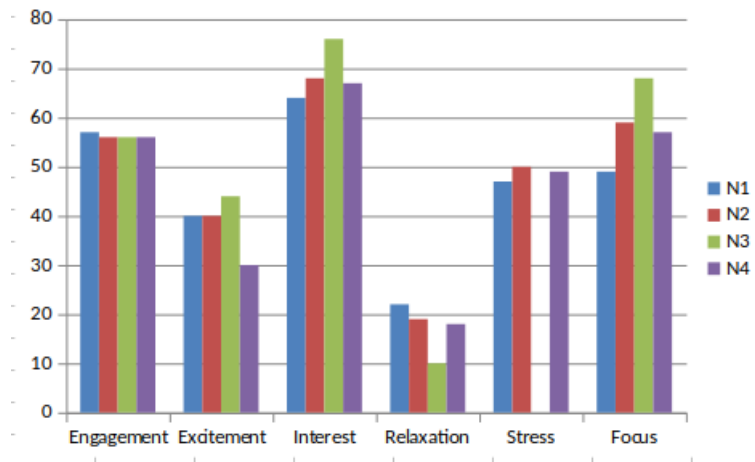


Figure 8: Coleta 3 results

- Collect 4: participants N1, N2 and N3.

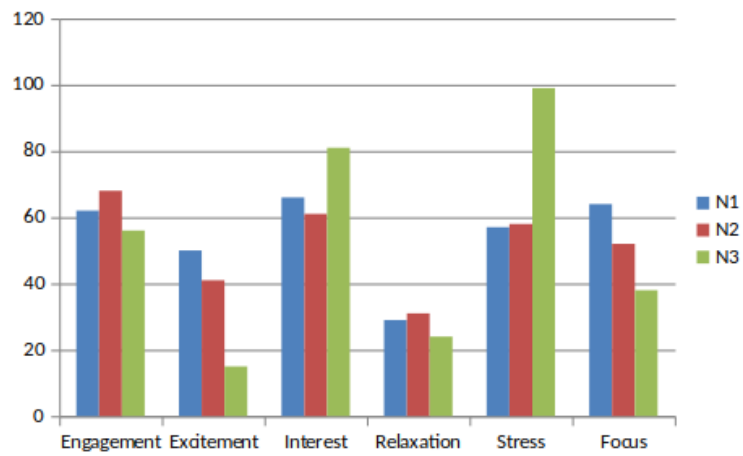


Figure 9: Coleta 4 results

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- Collect 5 : participants N1, N2 and N3..

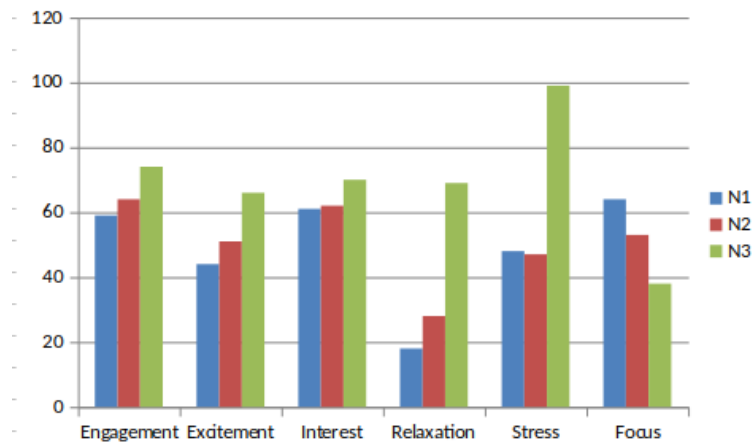


Figure 10: Coleta 5 results

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242

243

- Collect 6: Due to same personal problems student N3 did not participated in this data collecting. Participants N1 and N2.

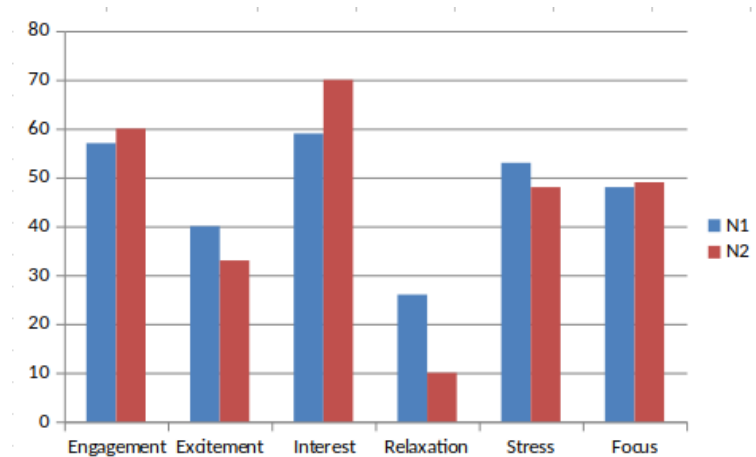


Figure 11: Coleta 6 results

## 244 6.1 validation

245 The used equipment Epoc+ from Emotiv is able to detect waves  
 246 of frequency from 0.16 Hz until 43 Hz(Comparison chart, 2019),  
 247 that means it can capture from Delta waves up to Gamma  
 248 waves. Furthermore, according to some researchers Beta and  
 249 Alpha waves are enough to emotion detection (Matlovic, 2016).

250 Relaxation and Stress have, both, increase and it may be  
 251 controversial, due to their contrary nature. Although, a possible  
 252 interpretation to that fact is that students would be more used  
 253 to university environment and all differences in their lives before  
 254 and after college, what could has made them more comfortable,  
 255 what would explain the relaxation increase. As well, the stress  
 256 increase could be explained by the university mood, which in  
 257 Brazil, is highly different from high school mood.

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