EEG study of emotional intelligence among adolescents

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Abstract

Much has been studied about Emotional Intelligence (EI), and it's impact on human behavior. However, psychophysiological basis of EI and its interconnection with progress in studying process is still actual. EI components reflects the ability to regulate the emotions. Ability to regulate the emotions and to be involved emotionally is effective strategy of achievements in educational process. Purpose of present research is EEG study of EI among adolescents and its interrelation with their achievements in educational process. Following methods were used: 1) TMMS questionnaire for EI; 2) EEG - electroencephalography Neuron Spectrum-1; 3) Grade Point Average (GPA) information was used as an indicator of educational achievement of the participants. As a result, present study showed that the reappraisal strategy of emotional regulation (by J. Gross, 2002), during educational task is significantly correlated with the scales of TMMS questionnaire (attention to emotion 0.185** and repair 0.237**), which reflects in left frontal gamma rhythm activation. In addition, theta rhythm well known as “emotional rhythm” has positive correlation with repair scale 0.239**. The effective emotional regulation strategy during educational process could lead the adolescents for better progress in their studies by using the emotions as major source of information. EI could be a predictor of success in perception and mastering the educational information, which supported by activity of left frontal gamma rhythm and theta rhythm oscillations.

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1. Introduction

The present study is devoted to emotional intelligence (EI) and its psychophysiological bases, its differences during the educational task and process of emotional regulation. The interrelation of emotional intelligence with parameters of electric activity of brain, as indicator of a functional condition, in situations of various strategy of emotional regulation during educational task is investigated.

There are variety definitions used to describe emotional intelligence, such as emotional competence, literacy, etc. (Humphrey et al. 2007). However, a problem with EI is that there is no clear definition of what emotional intelligence is. Mayer et al. (2004), developed model of EI comprising four abilities: (a) perceiving emotion; (b) use of emotion to facilitate thought; (c) understanding emotions; and (d) managing emotion, i.e. “to reflectively regulate emotions so as to promote emotional and intellectual growth”. Nevertheless, the urgency of present research is caused first of all by relative novelty of the given concept in world psychological science and existence of sets of contradictions in the theoretical approach to given direction.

Despite popularity, greater practical importance and all the criticisms around EI concept, there has been a growing interest in the application of EI to higher education. Alan Mortiboys (2005) explores the relevance and application of EI to teaching practice in his book Teaching with Emotional Intelligence. He uses counselling concepts to make his case for teaching. Turner & Curran (2006) suggest that attention is facilitated by positive emotional engagement, can promote student engagement by making their sessions interesting, communicating well and allowing time for questions. This requires EI in the sense of awareness of the interpersonal and intrapersonal factors to help manage emotions.

Though there are plenty of psychological researches of emotional intelligence in the western and American literature, only a few works are studying the features of brain activity in correlation with individual differences in emotional intelligence. It is widely known, that emotional conditions and their regulation possess psychophysiological mechanisms finding their own reflection in electric activity of brain. Accordingly, individual differences in emotional intelligence as abilities to achieve better educational progress and to distinguish and supervise emotions, should find the reflection in electric activity of brain.

Methodological and theoretical basis of our research is the idea of individual ability to reflect and regulate emotions, in accordance with the emotional regulation theory of J. Gross (2002). According to this theory, the model of emotion regulation process is conceptual structure which assumes, that various forms of emotional regulation have various consequences. So, according to J. Gross (1998) there are various strategies of regulation of emotions, such as reappraisal which occur enough early in emotion-generating process and consists of change (replacement) of the way of perception of arisen situation for reduction of its emotional influence. The second, suppression, which arises later in emotion-generating process and consists of braking attributes directed outside of internal feelings.

Experimental scientific research reveals that reappraisal is often more effective than suppression. Reappraisal reduces emotional experience and behavioral expression, and has no influence on memory. On the contrary, suppression reduces behavioral expression of emotions, but can not reduce emotional experience, and bring actually harm to memory. Suppression also increases the physiological response of suppressors and their social partners.

Thus, study of emotional intelligence is the important theoretical and practical problem demanding methodological development and empirical research.

2. Purpose and Methods of the study

Purpose of present research is EEG study of EI among adolescents and it's interrelation with their achievements in educational process.

3. Research methods.

The following methods were used in present study:
1) TMMS questionnaire for EI, which was developed to provide an index of individual differences in a mood regulation process termed the "metha-mood experience" that involves monitoring, evaluating, and regulating the emotions (Salovey et al., 1995);
2) EEG - electroencephalography;
3) Grade Point Average (GPA) information was used as an indicator of educational achievement of the participants

4. Design of the experiment.

With the purpose to investigate the EI of participants and its interrelation with their educational achievement there were conducted experimental research in 3 stages. First of all, participants were randomly collected and were tested by TMMS questionnaire for EI. Secondly, the EEG record using the electroencephalograph «Neuron-Spectrum-1» according to system of 10-20 % from symmetric points - Fp1, Fp2, F3, F4, F7, F8, C3, C4, P3, P4, T3, T4, T5, T6, O1, and O2 monopolarly concerning ear electrodes was made. Subjects were in the dark room isolated from noise and electromagnetic waves. EEG record was made during presentation of several educational problems in following order: background activity in the condition of closed eyes (1 minute); background activity in the condition of baseline (1 minute); during watching a video with educational problem (3 minutes); background activity in the condition of baseline (1 minute); during watching a video participants should try to regulate whatever emotion they would feel and imagine that they solved this educational problem, in other words they should reappraise the emotion that they have got. Second task was to suppress the emotion and not to show it.

Thus, all participants were given various tasks to track a difference between different strategies that they use during emotional regulation. At the end the GPA information of the participants was used to follow and analyze their educational achievements and how these achievements are interrelated with their EI.

5. Findings.

The TMMS questionnaire revealed that the “attention to emotion” scale shows higher results, which means that the participants are tend to pay more attention to their emotions in comparison with the clarity and repair scales. See details in Table 1.

Table 1. – TMMS data among participants

<table>
<thead>
<tr>
<th>TMMS scales</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention to emotion</td>
<td>57.93</td>
<td>10.62</td>
</tr>
<tr>
<td>Clarity</td>
<td>44.14</td>
<td>7.87</td>
</tr>
<tr>
<td>Repair</td>
<td>28.04</td>
<td>6.03</td>
</tr>
</tbody>
</table>

The results of TMMS questionnaire graphically can be seen in Fig.1.
As it seen in Table 1 and Fig.1, most of the participants pay attention to their emotions, whereas Clarity and Repair parameters of EI are shown in average level.

With the purpose to reveal the most significant indicator of a functional condition of a brain the factor analysis of all subjects’ EEG parameters as a result of significant factors of EEG level have been revealed, and been lead. According to the purpose of our research during EEG data processing we have concentrated on the analysis of parietal and frontal zones in EEG. According to literary data the given areas of a brain are attending in processes of emotional regulation.

Study of interrelation of emotional intelligence and EEG has revealed the correlation with range scale, it was found out only during the «reappraise» task. It is known, that cognitive loading is accompanied by synchronization scale of waves. Recently the increasing attention has been paid to scale of activity, which is fastest wave, reflecting cortex-cortical mutual relations (Munk, 2001). Results of our research have shown the presence of interrelation of left frontal scale of activity with the “Attention to emotions” scale and “Repair” scale during educational task (attention to emotion 0.185** and repair 0.237**). It is necessary to emphasize, that the attention to emotions defines also ability for Repair, being indissoluble as cognitive processes of attention and the control of cognitive functions (Simonov, 1981). It is an interesting fact, that theta rhythm which is considered «an emotional rhythm» (Izard, 1980), has revealed positive correlation with Repair 0.239**. In addition, the parameter “Attention to emotions” positively correlated with beta activity in the left frontal area, being also the indicator of cognitive regulation during the educational task. The correlation is seen in Table 2.

Table 2. Correlation between EEG parameters and TMMS scales

<table>
<thead>
<tr>
<th>Variables</th>
<th>Attention to emotion</th>
<th>Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left frontal scale</td>
<td>0.185**</td>
<td>0.237**</td>
</tr>
<tr>
<td>Theta rhythm</td>
<td>0.039**</td>
<td></td>
</tr>
</tbody>
</table>

It is necessary to note, that during the task “suppress the feelings” significant correlations between parameters of TMMS and EEG have not been revealed.

The received result helps us to assume, that EI parameters likely to predict success during emotion regulation.

Grade Point Average (GPA) information was analyzed in comparison with the EI scales, which is seen in Table 3.

Table 3. GPA and TMMS scales

<table>
<thead>
<tr>
<th>TMMS scales</th>
<th>Mean TMMS scales</th>
<th>Mean GPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention to emotion</td>
<td>57.93</td>
<td></td>
</tr>
<tr>
<td>Clarity</td>
<td>44.14</td>
<td>3.70</td>
</tr>
</tbody>
</table>
As it seen in Table 3, the descriptive statistics of GPA information of the participants and its interrelation with the EI scales is as follows: the average mean of the participants' GPA is 3.70. As a result, the educational progress measured by GPA shows the ability of the participants to pay attention to their emotions, clarify and repair their emotional states as well as regulate their emotions during the educational task.

6. Conclusion

The major conclusion is the fact, that emotional intelligence is interconnected with activity of frontal lobe of brain during emotional regulation by reappraisal of situation. It also confirms our assumption about reappraisal strategy in high degree which involves cognitive regulation expressed in activation of «cognitive rhythms» of the left frontal area of brain in comparison with suppression strategy. The most important result also is the conclusion that the Repair scale is interconnected with the activation level of frontal area of brain during educational task, which shows the effective emotional regulation strategy during educational process. It could lead the adolescents for better progress in their studies by using the emotions as major source of information. EI could be a predictor of success in perception and mastering the educational information, which supported by activity of left frontal gamma rhythm and theta rhythm oscillations. The GPA information of the participants also shows the role of EI in educational progress.

References