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PHOTOSYNTHETIC OXYGEN AND ITS INFLUENCE ON STRESS IN UNDAC- 2023 STUDENTS

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Abstract: The objective of the study is to measure the influence of oxygen produced in a biogarden related to the stress of underachieving students in the computer and systems studies program. Adopting a quantitative approach, observation sheets, questionnaires and climate sensor data were used in a biogarden described in the research oxygen release from the organic plant *sansevierias* to reduce polycythemia in the greenhouse year 2020. The research, applied and non-experimental, focuses on 5 students facing stress in addressing questions in a 10th cycle process automation course. With a purposive non-probabilistic approach for the sample, they were evaluated with descriptive statistics, Microsoft Excel and SPSS. Concluding that the optimal conditions of the bio-orchard improve oxygen production, reducing stress in the students. Some show signs of physiological alterations associated with stress, but oxygen saturation increased from 87% to 100%, and heart rate remained within normality, decreasing stress by 40% according to the psychological test.

Keywords: Environmental environment, Mental health, Academic performance, Photosynthetic oxygen, Biogarden, Air quality, Student stress, Environmental oxygen quality, University environment.

INTRODUCTION

For a long time nature has balanced the existence as a human species, now with the industry and the automobile fleet, added to this the depredation of green areas, consequently, there is a demand for oxygen, however, oxidative stress must also be known (PENTA, 2020). Currently, the university is facing significant challenges related to improving student well-being and academic performance. Stress has emerged as a prominent factor that considerably influences the university experience in students, with direct repercussions on their mental health and academic performance. Therefore, the study is

situated at the convergence of various disciplines in addressing the interaction between the environmental setting, mental health and academic performance of students. The relevance of photosynthetic oxygen generated in the biogarden is highlighted as a key element to improve air quality, bringing tangible benefits to the reduction of student stress associated with academic activities. The approach adopted is holistic and multidisciplinary, incorporating knowledge of psychology and environment to achieve a more complete understanding of the relationship between oxygen quality, students' mental well-being and their academic performance

Dallorso et al. (2020) emphasizes how public policies oriented to knowledge not only contribute to the training of students, but also generate positive impacts on society and the environment. In the research of Delgado Alzamora et al. (2022) studies oxygen saturation and stress in a sample of 169 pregnant women finding a relationship for low level saturation of 95 and 100% and 87.6 for a medium level stress, in another research of Velásquez Marcos (2022) stress causes a decrease in oxygen saturation having as a theme stress and anxiety that are present in a pathological form causing dizziness and choking sensations.

Ibi and Yabe-Nishimura (2020) highlight the importance of oxidative stress, documented in previous clinical studies with depressed patients, where reactive oxygen species (ROS) play a crucial role. These ROS, interacting with proteins, lipids and DNA, not only act as signaling molecules, but also induce cell damage. Likewise (Martinez-Angeles et al., 2023) investigated the relationship between blood oxygen levels and mental alterations, particularly depression, anxiety and stress. The results revealed a mathematical model that describes a significant relationship between blood oxygenation and stress, anxiety and depression in students, together with respiratory frequency.

Liu et al. (2022) in their literature review obtain that cerebral blood flow autoregulation is significantly impaired in depressed patients, increased oxidative stress, and monoamine neurotransmitter disorders. Their findings suggest that the mechanisms underlying cerebral blood flow alteration in depression are linked to various biological and neurochemical factors.

Córdova Olivera et al. (2023) addressed the relationship between academic stress and mental health in undergraduate university students, with the aim of understanding and reducing the associated negative effects, where 1,265 students from a private university in Bolivia were examined. The results revealed a significant correlation between high levels of academic stress and the likelihood of experiencing languishing mental health. These results underscore the importance of addressing self-imposed pressures to improve students' mental health and highlight the need for specific interventions focused on managing self-inflicted stress in academic settings.

Balban et al. (2023) The study examined the efficacy of three daily breathing exercises of 5 minutes each, noting that cyclic sighs, focusing on prolonged exhalations, proved to be especially effective. Compared to mindfulness meditation, these findings suggest that the daily practice of cyclic sighing is a promising and effective tool for stress management. Also (Dönmez et al., 2023) studied the positive impact of laughter yoga on the reduction of anxiety and stress experienced by nursing students during clinical simulation-based teaching at the University of Turkey, in which 88 students were randomly assigned to an intervention group that participated in laughter yoga sessions prior to simulation scenarios and a control group that only received simulation training. As a result, the intervention group experienced significantly lower levels of anxiety, perceived stress, heart rate and blood pressure compared to the control group.

The rationale for this research is based on the strong evidence from several studies highlighting the direct influence of oxygen on stress mitigation. Although these investigations have explored this phenomenon in sea level environments, there is a significant lack of understanding of how this process operates at high altitudes, particularly in the city of Cerro de Pasco. Given the unique geographic location and considerable altitude, this study aims to address this knowledge gap by exploring how specific altitude conditions may modulate the relationship between oxygen and stress mitigation. In addition to its academic relevance, the research seeks to provide social justification by addressing specific challenges faced by the population. The results will not only enrich scientific knowledge, but will also open possibilities for the implementation of projects that improve the quality of life of the citizens of this region.

The general objective of this study is to measure the influence of oxygen produced in a bio-orchard on the stress of students with low academic performance in the systems and computer engineering program. It is also subdivided into specific objectives such as: to determine the levels of oxygen produced by the biogarden in different climatic conditions, to determine the stress in the students of systems and computer engineering, and to determine the influence of oxygen levels on the decrease of stress in students with low academic performance.

MATERIALS AND METHODS

The research adopts a quantitative approach, supported by the choice of data collection instruments such as observation sheets and the psychological questionnaire, as well as the use of data from climatic sensor readings in a bio-orchard. The research Palomino et al. (2020) stands out, where it focuses on the release of oxygen from the organic plant *sansevierias* to reduce polycythemia in a greenhouse in Cerro

de Pasco. The research design is of applied and non-experimental transactional type, focused on 5 students with low academic performance who experience academic stress when addressing questions about the implementation of a web server with the ESP32 microcontroller in the process automation course of the X cycle of the Professional Training School of Systems and Computer Engineering. In relation to the sample, a purposive non-probabilistic approach was chosen, justified by the applied and descriptive nature of the research.

In terms of statistical procedure, descriptive statistics were applied and computer tools such as Microsoft Excel were used to organize the questionnaire and the results of the Likert scale, as well as to generate graphs of aptitude behavior per student. In addition, SPSS statistical software was used to obtain frequency tables for each question of the psychological test, providing a comprehensive and rigorous approach to the research.

RESULTS AND DISCUSSION

The psychological test addressed the following topics: different strategies to face problems, search for concrete solutions and positive action, negative or destructive attitudes, anger (bad mood) with other people, search for social support, and spiritual reflection, where students recorded their answers from never to almost always; table 1 shows the number of correct answers on this scale.

Figure 1 shows the total consolidation of hits per scale and student of the psychological test, highlighting the highest frequency (57) in the never and sometimes scales, which implies normal behavior with a tendency to a pessimistic or rare attitude.

Table 2 provides information on blood oxygen saturation (%SpO2) and heart rate (PRbpm) levels of five students in different ranges. These parameters are important indicators of physiological health that are immer-

sed to the effects by stress. Therefore, it was analyzed how the given values could be related to physiological alterations.

| Students | Saturation levels | |
|----------|-------------------|-------|
| | %SpO2 | PRbpm |
| 1 | 89-93 | 83-96 |
| 2 | 87-97 | 89-94 |
| 3 | 95-100 | 94-98 |
| 4 | 90-94 | 72-76 |
| 5 | 89-93 | 68-74 |

Table 2. Physiological alterations generated by stress

Some important questions of the psychological questionnaire were selected, under the criterion of significance, in order to describe their statistical results organized in tables so that their analysis would not be so extensive.

Table 3 shows that most of the participants selected positive responses, where 40% indicated that they sometimes tried to analyze the causes, another 40% did so frequently, and the remaining 20% stated that they did so almost always. These valid percentages show the relative distribution of positive responses. Also, the cumulative percentage reveals that 80% of the participants try to analyze the causes of the problem with some frequency or with constant frequency.

In Table 4, 40% of the participants indicated that they never take their bad moods out on others, while another 40% do it sometimes. In addition, 20% admitted to doing so frequently. The cumulative percentage provides a detailed view of the distribution of responses, highlighting that 80% of participants, combining the “Never” and “Sometimes” categories, report not doing so frequently.

Table 5 shows that 40% indicated that they never offended other people, while 60% admitted to having done so “Few times”. The cumulative percentage reflects the gradual distribution of responses, reaching 100% with the “Few times” category. These data suggest that the majority of participants acknowledge having offended certain people on limited occasions.

| No. Student | Never | Few times | Sometimes | Frequently | Almost always |
|--------------|-----------|-----------|-----------|------------|---------------|
| Student 1 | 10 | 10 | 9 | 12 | 1 |
| Student 2 | 20 | 9 | 8 | 4 | 1 |
| Student 3 | 9 | 12 | 14 | 7 | 0 |
| Student 4 | 10 | 14 | 7 | 11 | 0 |
| Student 5 | 8 | 11 | 19 | 4 | 0 |
| Total | 57 | 56 | 57 | 38 | 2 |

Table1. Psychological test frequencies

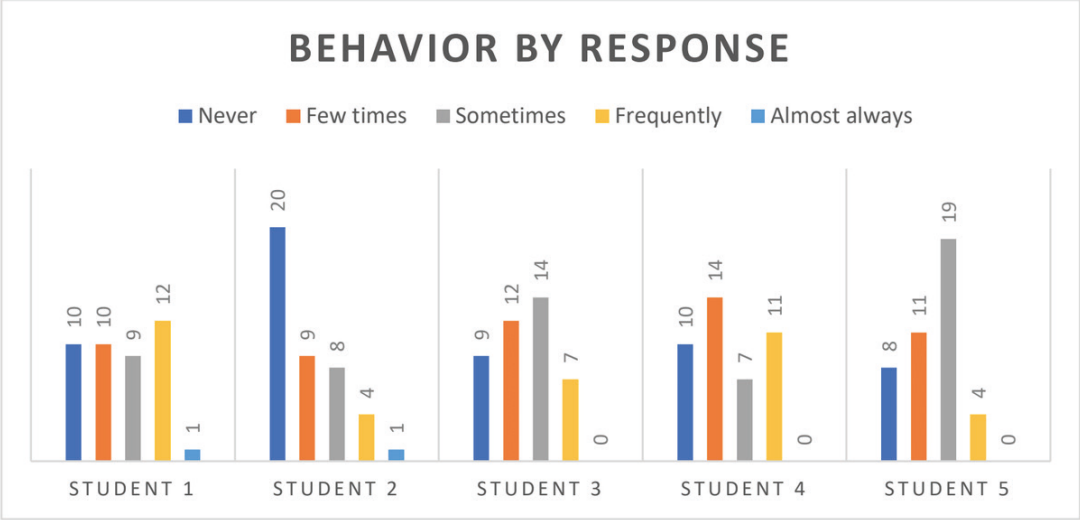


Figure1. Frequency analysis

I tried to analyze the causes of the problem in order to address it.

| | | Frequency | Percentage | Valid percentage | Cumulative percentage |
|-------|---------------|-----------|--------------|------------------|-----------------------|
| Valid | Sometimes | 2 | 40,0 | 40,0 | 40,0 |
| | Frequently | 2 | 40,0 | 40,0 | 80,0 |
| | Almost always | 1 | 20,0 | 20,0 | 100,0 |
| | Total | 5 | 100,0 | 100,0 | |

Table3. Question 1 of the Psychological Questionnaire

I unloaded my bad mood on others

| | | Frequency | Percentage | Valid percentage | Cumulative percentage |
|-------|--------------|-----------|--------------|------------------|-----------------------|
| Valid | Never | 2 | 40,0 | 40,0 | 40,0 |
| | Sometimes | 2 | 40,0 | 40,0 | 80,0 |
| | Frequently | 1 | 20,0 | 20,0 | 100,0 |
| | Total | 5 | 100,0 | 100,0 | |

Table 4. Question 4 of the psychological questionnaire

I offended certain people

| | | Frequency | Percentage | Valid percentage | Cumulative percentage |
|-------|--------------|-----------|--------------|------------------|-----------------------|
| Valid | Never | 2 | 40,0 | 40,0 | 40,0 |
| | Few times | 3 | 60,0 | 60,0 | 100,0 |
| | Total | 5 | 100,0 | 100,0 | |

Table 5. Question 11 of the psychological questionnaire

Table 6 shows that 40% of the participants have sought advice “Few times”, followed by 20% who have done so “Never” or “Sometimes”, and another 20% who have done so “Frequently”. The cumulative percentage indicates that 60% have sought advice “Few times” and 20% have done so both “Sometimes” and “Frequently”, reflecting a variability in the frequency with which people turn to their close relationships for guidance in the face of problems, with the majority opting to do so occasionally. The low frequency in the “Never” category indicates a general willingness to seek social support.

Table 7 shows that the option “Sometimes” is the most selected option, representing 40% of the responses, followed by “Frequently” also with 40%, where a significant percentage of the participants recognize their own contribution to the problem in different degrees, either occasionally or frequently. In addition, it is noteworthy that no participant selected the option “Few times”, indicating a possible tendency towards a greater self-attribution of responsibility.

In Table 8, 20% indicated that they rarely implement concrete solutions to the problem, while 40% do so sometimes and another 40% do so frequently. This analysis reveals a diversity in the strategies adopted by participants to address problems, with a significant proportion showing a tendency towards frequent application of concrete solutions. The cumulative percentage indicates that 60% of the participants apply concrete solutions at least sometimes, suggesting a general disposition towards direct action to address problems among the respondents.

Table 9 shows that 60% of the participants indicate that they practice sports sometimes in order to distract themselves from their problems, while 20% do it never and another 20% do it rarely. According to the accumulated percentage, 60% of the group uses this activi-

ty occasionally as a way to forget their worries, so most of them practice sports as an effective strategy on certain occasions to counteract the negative impact of the problems in their lives.

Table 10 shows that 40% of the participants declared that they never tried to forget everything, while 20% did it a few times, another 20% sometimes, and the last 20% frequently. The cumulative percentage indicates the proportion of responses in relation to the total, showing that 60% of the individuals tried to forget everything to some extent. These data suggest a variety in the strategies used by participants to cope with stressful situations, highlighting that a significant proportion actively seek to forget about their worries to varying degrees.

The average values of oxygen concentration obtained inside (21.050%) and outside (19.699%) of the bio-orchard are shown in Figure 2.

DISCUSSION

The most significant findings to physiological alterations generated by stress per student are:

For student 1, oxygen saturation levels (%SpO₂: 89-93) are in the lower range, and heart rate (PRbpm: 83-96) is in a normal range. The low oxygen saturation suggests a possible physiological response to stress, since the body can experience changes in breathing, and according to Table 9 when answering the question, I practiced some sport to forget about the problem I point out few times, evidencing a significant picture of stress.

In Student 2, oxygen saturation levels are varied (%SpO₂: 87-97), but heart rate is in a normal range (PRbpm: 89-94). Similar to Student 1, the variability in oxygen levels is related to stress, according to Table 9 I answer sometimes.

Ask a relative or friend for advice on how to deal with the problem.

| | | Frequency | Percentage | Valid percentage | Cumulative percentage |
|-------|------------|-----------|------------|------------------|-----------------------|
| Valid | Never | 1 | 20,0 | 20,0 | 20,0 |
| | Few times | 2 | 40,0 | 40,0 | 60,0 |
| | Sometimes | 1 | 20,0 | 20,0 | 80,0 |
| | Frequently | 1 | 20,0 | 20,0 | 100,0 |
| | Total | 5 | 100,0 | 100,0 | |

Table 6. Question 13 of the psychological questionnaire

I realized that I was the main cause of the problem.

| | | Frequency | Percentage | Valid percentage | Cumulative percentage |
|-------|------------|-----------|------------|------------------|-----------------------|
| Valid | Few times | 1 | 20,0 | 20,0 | 20,0 |
| | Sometimes | 2 | 40,0 | 40,0 | 60,0 |
| | Frequently | 2 | 40,0 | 40,0 | 100,0 |
| | Total | 5 | 100,0 | 100,0 | |

Table 7. Question 16 of the psychological questionnaire

I tackled the problem by implementing several concrete solutions

| | | Frequency | Percentage | Valid percentage | Cumulative percentage |
|-------|------------|-----------|------------|------------------|-----------------------|
| Valid | Few times | 1 | 20,0 | 20,0 | 20,0 |
| | Sometimes | 2 | 40,0 | 40,0 | 60,0 |
| | Frequently | 2 | 40,0 | 40,0 | 100,0 |
| | Total | 5 | 100,0 | 100,0 | |

Table 8. Question 29 of the psychological questionnaire

I practiced a sport to forget about the problem.

| | | Frequency | Percentage | Valid percentage | Cumulative percentage |
|-------|-----------|-----------|------------|------------------|-----------------------|
| Valid | Never | 1 | 20,0 | 20,0 | 20,0 |
| | Few times | 1 | 20,0 | 20,0 | 40,0 |
| | Sometimes | 3 | 60,0 | 60,0 | 100,0 |
| | Total | 5 | 100,0 | 100,0 | |

Table 9. Question 33 of the psychological questionnaire

I tried to forget everything

| | | Frequency | Percentage | Valid percentage | Cumulative percentage |
|-------|------------|-----------|------------|------------------|-----------------------|
| Valid | Never | 2 | 40,0 | 40,0 | 40,0 |
| | Few times | 1 | 20,0 | 20,0 | 60,0 |
| | Sometimes | 1 | 20,0 | 20,0 | 80,0 |
| | Frequently | 1 | 20,0 | 20,0 | 100,0 |
| | Total | 5 | 100,0 | 100,0 | |

Table 10. Question 40 of the psychological questionnaire

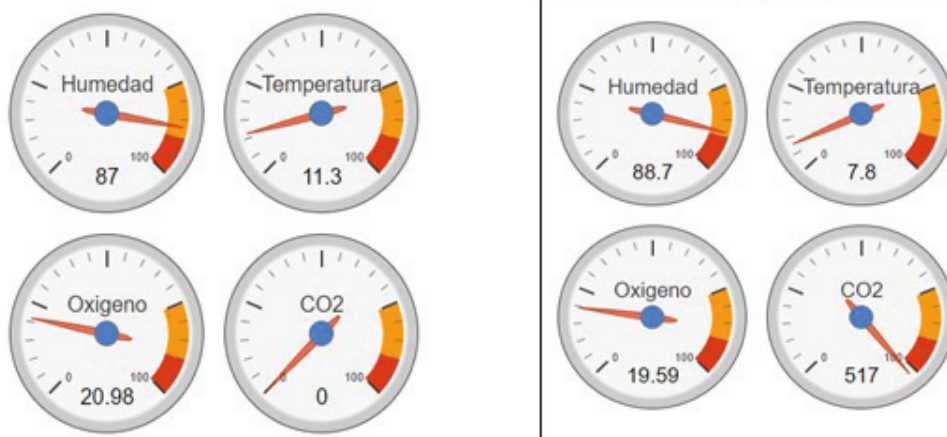


Figure 2. Oxygen concentration measurements

Note: (Palomino et al., 2020).

Similarly for student 3, these values are within normal and healthy ranges (%SpO₂: 95-100, PRbpm: 94-98). There is no direct evidence of physiological alterations related to stress, however, according to table 9 I answered never.

In student 4, there is a decrease in oxygen levels (%SpO₂: 90-94) and heart rate is in the lower range (PRbpm: 72-76). Indicating a response to stress, since the decrease in oxygen saturation could be due to changes in respiration associated with stress, and in the questionnaire referred to question 33 I answer sometimes.

In the student similar to Student 4, a decrease in oxygen levels (%SpO₂: 89-93) and heart rate is in the lower range (PRbpm: 68-74). This also suggests a possible physiological response to stress, and in the questionnaire referred to question 33 I answer sometimes.

In comparison with the results of the research conducted by Dönmez et al. (2023) in their study, application of laughter yoga as a stress reducer, the intervention group observed a decrease in stress to 58.22 (SD=26.13), and in the control group an increase of 74.88 (SD=19.37) in the nursing students, likewise, the study referred to the influence of photosynthetic oxygen in the academic stress of Systems and Computer Engineering students, Figure 1 and Table 2 show the progressive de-

crease of stress, being notorious in the oxygen saturation, due to the biogarden as a natural oxygen generator.

CONCLUSIONS

The optimal climatic condition of the bio-orchard, with a relative humidity of 43.033% and a temperature of 23.193 °C, proved to be conducive to improving the oxygen production performance of the organic plant sansevierias specifically, with indoor oxygen levels averaging 21.050%, significantly exceeding the 19.699% recorded in the outdoor environment.

Students 1, 4 and 5 show signs associated with stress-related physiological alterations, especially in terms of oxygen saturation, it is important to note that other factors, such as pre-existing health conditions, also influence these values.

The evaluation of physiological alterations related to stress, in terms of %SpO₂ saturation levels increased from 87 to 100 as well as a heart rate PRbpm from 80 to 84 on average (normal picture) because of the photosynthetic oxygen generated by the biogarden decreasing in (40%) of stress in low performing students according to the psychological test.

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ANNEXES

Annex1 . CAE. Coping with Stress Questionnaire.

Name:

Age:

Sex:

Instrucciones: En las páginas que siguen se describen formas de pensar y comportarse que la gente suele emplear para afrontar los problemas situaciones estresantes que ocurren en la vida. Las formas de afrontamiento descritas no son ni buenas ni malas, ni tampoco unas son mejores o peores que otras. Simplemente ciertas personas utilizan unas formas más que otras. Para contestar debe leer con detenimiento cada una de las formas de afrontamiento y *recordar en qué medida Vd. la ha utilizado recientemente cuando ha tenido que hacer frente a situaciones de estrés. Rodee con una cruz el número que mejor represente el grado en que empleó cada una de las formas de afrontamiento del estrés que se indican.* Aunque este cuestionario a veces hace referencia a una situación o problema, tenga en cuenta que esto no quiere decir que Vd. piense en un único acontecimiento, sino más bien en las situaciones o problemas más estresantes vividos recientemente *[aproximadamente durante el pasado año]*.

1 0 1 1 2 1 3 1 4 1

Nunca Pocas veces A veces Frecuentemente Casi siempre

¿Cómo se ha comportado habitualmente ante situaciones de estrés?

| PREGUNTA | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Traté de analizar las causas del problema para poder hacerle frente | 0 | 1 | 2 | 3 | 4 |
| Me convencí de que hiciese lo que hiciese las cosas siempre me saldrían mal | 0 | 1 | 2 | 3 | 4 |
| Intenté centrarme en los aspectos positivos del problema | 0 | 1 | 2 | 3 | 4 |
| Descargué mi mal humor con los demás | 0 | 1 | 2 | 3 | 4 |
| Cuando me venía a la cabeza el problema, trataba de concentrarme en otras cosas | 0 | 1 | 2 | 3 | 4 |
| Le conté a familiares o amigos cómo me sentía | 0 | 1 | 2 | 3 | 4 |
| Asistí a la Iglesia | 0 | 1 | 2 | 3 | 4 |
| Traté de solucionar el problema siguiendo unos pasos bien pensados | 0 | 1 | 2 | 3 | 4 |
| No hice nada concreto puesto que las cosas suelen ser malas | 0 | 1 | 2 | 3 | 4 |
| Intenté sacar algo positivo del problema | 0 | 1 | 2 | 3 | 4 |
| Insulté a ciertas personas | 0 | 1 | 2 | 3 | 4 |
| Me volqué en el trabajo o en otra actividad para olvidarme del problema | 0 | 1 | 2 | 3 | 4 |
| Pedí consejo a algún pariente o amigo para afrontar mejor el problema | 0 | 1 | 2 | 3 | 4 |
| Pedí ayuda espiritual a algún religioso (sacerdote, etc.) | 0 | 1 | 2 | 3 | 4 |
| Establecí un plan de actuación y procuré llevarlo a cabo | 0 | 1 | 2 | 3 | 4 |
| Comprendí que yo fui el principal causante del problema | 0 | 1 | 2 | 3 | 4 |
| Descubrí que en la vida hay cosas buenas y gente que se preocupa por los demás | 0 | 1 | 2 | 3 | 4 |
| Me comporté de forma hostil con los demás | 0 | 1 | 2 | 3 | 4 |
| Salí al cine, a cenar, a «dar una vuelta», etc., para olvidarme del problema | 0 | 1 | 2 | 3 | 4 |
| Pedí a parientes o amigos que me ayudaran a pensar acerca del problema | 0 | 1 | 2 | 3 | 4 |
| Acudí a la Iglesia para rogar que se solucionase el problema | 0 | 1 | 2 | 3 | 4 |
| Hablé con las personas implicadas para encontrar una solución al problema | 0 | 1 | 2 | 3 | 4 |
| Me sentí indefenso/a e incapaz de hacer algo positivo para cambiar la situación | 0 | 1 | 2 | 3 | 4 |
| Comprendí que otras cosas, diferentes del problema, eran para mí | 0 | 1 | 2 | 3 | 4 |

| | | | | | |
|---|---|---|---|---|---|
| más importantes | | | | | |
| Agredí a algunas personas | 0 | 1 | 2 | 3 | 4 |
| Procuré no pensar en el problema | 0 | 1 | 2 | 3 | 4 |
| Hablé con amigos o familiares para que me tranquilizaran cuando me encontraba mal | 0 | 1 | 2 | 3 | 4 |
| Tuve fe en que Dios remediaría la situación | 0 | 1 | 2 | 3 | 4 |
| Hice frente al problema poniendo en marcha varias soluciones concretas | 0 | 1 | 2 | 3 | 4 |
| Me di cuenta de que por mí mismo no podía hacer nada para resolver el problema | 0 | 1 | 2 | 3 | 4 |
| Experimenté personalmente eso de que «no hay mal que por bien no venga» | 0 | 1 | 2 | 3 | 4 |
| Me irrité con alguna gente | 0 | 1 | 2 | 3 | 4 |
| Practiqué algún deporte para olvidarme del problema | 0 | 1 | 2 | 3 | 4 |
| Pedí a algún amigo o familiar que me indicara cuál sería el mejor camino a seguir | 0 | 1 | 2 | 3 | 4 |
| Recé | 0 | 1 | 2 | 3 | 4 |
| Pensé detenidamente los pasos a seguir para enfrentarme al problema | 0 | 1 | 2 | 3 | 4 |
| Me resigné a aceptar las cosas como eran | 0 | 1 | 2 | 3 | 4 |
| Comprobé que, después de todo, las cosas podían haber ocurrido peor | 0 | 1 | 2 | 3 | 4 |
| Luché y me desahugué expresando mis sentimientos | 0 | 1 | 2 | 3 | 4 |
| Intenté olvidarme de todo | 0 | 1 | 2 | 3 | 4 |
| Procuré que algún familiar o amigo me escuchase cuando necesité manifestar mis sentimientos | 0 | 1 | 2 | 3 | 4 |
| Acudí a la Iglesia para poner velas o rezar | 0 | 1 | 2 | 3 | 4 |

Annex2 . Physiological and psychological testing of underperforming students.



Annex3 . Photosynthetic oxygenation

