# The Effectiveness of Virtual Reality Exposure Therapy Module for Reducing Acrophobia Symptoms

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**Abstract**. The amount of places that require a person to be in high-altitude circumstances is a barrier for people who are afraid of heights or also known as acrophobia. The therapist can offer a 3D stimulus using Virtual Reality (VR), making it a more efficient alternative to exposure treatments. Virtual Reality Exposure Therapy is the practice of exposing oneself to a fearful stimulus via a VR camera (VRET). The purpose of this study is to determine the effectiveness of the VRET module in reducing acrophobia symptoms. The pretest-posttest control group design was utilized in the study. Participants with acrophobia were separated into two groups: the control (*n*=14) and the experimental (*n*=15) who received VRET treatment. They completed the Acrophobia Questionnaire (AQ) before and after the nine VRET sessions. Compared to control condition, participants in the experimental group reported lower scores in AQ-Anxiety and AQ-Avoidance. Furthermore, each exposure session results in a significant decrease in psychological assessments utilizing the State-Trait Anxiety Inventory and Autonomic Perception Questionnaire scales. A significant decrease has also occurred in the Respiratory Rate and Skin Conductance indicators. According to the findings of this study, the VRET module is effective in reducing the psychological and physiological symptoms of acrophobia.

*Keywords*: acrophobia; physiological responses; skin conductance; virtual reality exposure therapy

The rapid advancement of the wheels of development in Indonesia is distinguished by the development of public facilities and infrastructure. Many facilities and infrastructure are currently being built that require people to be in high-altitude settings. The mode of air transportation is one of the infrastructures that is rapidly progressing. At the moment, the rise of air transportation in Indonesia can be described as rapid (Pamudji, 2016). The second phenomenon associated with the installation of facilities that require people to be in a high-altitude situation is the construction of many high-rise buildings. To meet the demand for housing and commercial space, one option is to construct vertical structures in the form of tall buildings, which can house residences, office hotels, and business centers (Sugiyanto & Wena, 2019). Indonesia is even ranked fourth in the world for tall-building construction, trailing only the Philippines, Qatar, Malaysia, Singapore, Thailand, the United Arab Emirates, and Australia (Sindo, 2017).

Every creature needs the ability to deal with danger. Learning to recognize, avoid, and respond effectively to threatening situations can improve survival. As a result, dread or anxiety becomes an anticipatory emotion generated by a situation that poses a threat to the individual's safety, assisting individuals in identifying the hazardous thing (Garcia, 2019). According to general population surveys, many people are terrified of a variety of

things, including death, some animals, heights, public speaking, surgical or medical operations, and catastrophic conditions (McLean & Woody, 2001).

A specific phobia is an excessive dread of a specific stimulus. According to the DSM-5, specific phobia is a disease defined by illogical and persistent fear or anxiety about specific events or things known as phobic stimuli (*American Psychiatric Association*, 2013). Specific phobias are divided into several types including; animal, natural environment, blood-injection-injury, situational, and other types that are not included in the categories mentioned above (APA, 2013).

One type of specific phobia is acrophobia or what is known as a phobia of heights. In one study, it was shown that in the specific phobia category, acrophobia had the highest prevalence in the general population at 4.9% (Depla et al., 2008). This is in line with research conducted by Eaton et al. (2018) which states that acrophobia is the most common phobia category that occurs in addition to the phobia of animals. The behavior of individuals who have acrophobia usually involves avoiding various situations related to heights such as climbing stairs, terraces, apartments, tall buildings, bridges, elevators, and traveling by plane (Coelho & Wallis, 2010).

Several types of therapies, such as relaxation, cognitive therapy, and exposure therapy, have been widely employed to treat specific phobia disorders (Singh & Singh, 2016). The exposure-based approach is the most effective treatment method for dealing with phobic disorders (Richard & Lauterbach, 2007; Wolitzky-Taylor et al., 2008). Although in-vivo exposure is usually the best option, it frequently causes issues such as the client's refusal to participate and difficulties in preserving the required confidentiality and security (Ferrer-Garcia et al., 2019). On the other side, imaging techniques necessitate a high level of cognitive ability to visualize the dreaded stimulus and can exhaust individuals (Ferrer-Garcia et al., 2019). To circumvent the limits of exposure therapy, new research has embraced Virtual Reality (VR) media as a treatment option that is considered safer and more cost-effective.

Users may see and interact with virtual surroundings and objects thanks to VR technology. VR creates a 3D virtual environment using computer simulations and allows users to view virtual things in real time (Tsai et al., 2018). Animal phobia, panic disorder, social anxiety, PTSD, Generalized Anxiety Disorder, and acrophobia have all been shown to benefit from virtual reality exposure (Wiederhold & Bouchard, 2014). Virtual reality exposure therapy refers to the use of exposure therapy through virtual reality technology (VRET) (Brahnam & Lakhmi, 2011). VRET is currently regarded as a viable alternative to exposure treatment since it can produce fear and anxiety, hence serving as an alternative method of creating exposure (Krijn et al., 2004). Furthermore, when using the VR system, neither the therapist nor the patient is required to leave the consultation room. This can save both therapists and clients time and money (Cavanagh & Shapiro, 2004). The importance of VR exposure is that it provides a safe setting in which patients can explore and test theories and build more effective coping mechanisms (Wiederhold, 2019).

Juan and Pérez (2010) revealed findings in acrophobia, Augmented Reality (AR), and Virtual Reality Exposure Therapy (VRET) in their study. This study demonstrated that VRET was just as effective as in vivo exposure. Costa et al. (2014) and Emmelkamp et al. (2001) found that VRET is beneficial for lowering anxiety in acrophobic patients.

Specific phobias are typically viewed from three perspectives: behavioral, physiological, and cognitive (McLean & Woody, 2001). These three components are common to all levels of anxiety, and are, to some extent, normal and adaptive responses. In the face of dangerous conditions, behavioral components such as avoiding or fleeing have clear survival benefits. Cognitive components, such as hypervigilance, can give early warning systems for recognizing potentially dangerous situations. The physiological response allows the organism to plan defense options like fight or flight.

The assessment of physiological activation during exposure therapy is regarded as an important component in the treatment of a variety of anxiety disorders (Diemer et al., 2016). Heart rate, Heart Rate Variability (HRV), respiration rate, and skin conductance are all physiological signs that are often used to identify a person's level of anxiety. As a result, the researcher sought to determine whether VRET may alleviate acrophobia symptoms by examining changes in psychological and physiological signs.

## Methods

### Research design

The method used in this research was an experiment in a laboratory setting. The research design used was the pretest-posttest control group design (Shadish et al., 2002). As mentioned by Azwar (2017) that the pretest-posttest control group design is one of the most widely used experimental designs in intervention module validation studies.

### Research Participants

Participants were recruited via online announcements and met the inclusion criteria, which included having an Acrophobia Questionnaire (AQ) score ranging from moderate to very high. Participants were also between the ages of 19 and 60, did not have dangerous conditions (such as heart disease, asthma, or hypertension), did not have concurrent mental disorders, had an AQ-Anxiety score ranging from 46 to 108, and were willing to sign the informed agreement. The 29 individuals were split into two groups: the experimental ($n$=15) and the control ($n$=14). The experimental group received VRET treatment, whereas the control group received no treatment.

### Materials

This study's materials included a virtual reality environment, biofeedback, and a psychological scale. In this study, a Vive Pro Eye camera (Figure 1) was used. This camera

displays a stimulus that has been designed and developed specifically for its purpose. The stimuli offered in this study is a height situation (Figure 2), which is a 3-dimensional stimulus that depicts a situation in an elevator on the first level that subsequently climbs up to the third floor and the elevator door opens. Participants can explore the area from the third floor, and then take the elevator to the building's tenth floor. Participants witnessed the view from the top of the skyscraper after the elevator door opened. Next, participants were asked to walk on a hanging board and pick up a cat. This virtual environment has gone through an expert judgment procedure involving 12 raters consisting of expertise in information technology, animation, game design, software, programmers, and psychology. The raters rated the virtual environment and its suitability against the immersiveness indicator. Based on the analysis, it is known that the coefficient of Aiken's V is 0.76. This means that the designed virtual environment has met the aspects that support immersiveness.

**Figure 1.**

*HMD Vive Pro Eye*



**Figure 2.**

*Height Stimulus Situation*

**Figure 3.**

*Biofeedback ProComp5 Infiniti*



**Figure 4.**

*Small Stage with Handrail*



The biofeedback used in this study is the ProComp5 Infiniti biofeedback system developed by Thought Technology Ltd (Figure 3). ProComp5 Infiniti is a diagnostic tool that in this study can measure heart rate, skin conductance, and respiratory rate. Information collected from sensors attached to participants is transmitted to computers via fiber optic cables. The software used to calculate the signal received from the sensor is BioGraph Infiniti Software V6.0 which was also developed by Thought Technology Ltd.

*Heart rate*

Heart rate (HR) is the amount of heartbeats per minute produced by measuring blood volume pulse (BVP). BVP reflects infrared light on the surface of the skin and measures the amount of reflected light. This amount varies depending on the amount of blood in the skin. Every time the heart beats, there will be a lot of blood under the skin and then the blood will reflect red light so more light will be reflected.

*Respiration rate*

The respiration rate is measured using a respiration sensor. Respiration sensor is sensitive to stretching. When looped on the client's chest or abdomen, the respiration sensor will change the expansion/contradiction of the rib or abdomen to the ups and downs of the signal displayed on the screen.

*Skin conductance*

Skin conductance is a measure of the skin's ability to conduct electricity. A small electrical voltage is generated through two electrodes, usually affixed to two fingers in one hand, to build an electrical circuit where the client becomes a variable resistor. Real-time variation in conductance, which is the opposite of resistance, is calculated. SC represents changes in the sympathetic nervous system. When a person becomes more or less stressed, skin conductance increases or decreases proportionately. Skin conductance, galvanic skin response, and electro-dermal response (EDR) are different terms for similar physiological actions.

The Acrophobia Questionnaire (AQ) was designed to assess the level of fear and avoidance in height settings. Cohen (1977) created a questionnaire in the form of a self-report with 40 items (20 items on the Anxiety subscale and 20 items on the Avoidance subscale). The Anxiety subscale, which consists of 20 items, was employed as a participant screening tool in this investigation. This refers to the study of Steinman and Teachman (2011), which employs a similar technique. As a pre-and post-test, the total AQ scale (anxiety and avoidance subscales) was delivered. Individuals score the scale concerning 20 various altitude scenarios. The anxiety subscale response options ranged from 0 (extremely not anxious/not avoiding) to 6 (very anxious/avoiding). Based on the results of delivering a scale to 120 respondents, it was known that the coefficient of Cronbach's Alpha = .937, $\alpha > 0.5$. Through the method of professional judgment carried out by 10 raters (students of professional psychology in the clinical sector), it is also known that the content validity coefficient of Aiken's V is 0.867. AQ blueprint is provided in table 1.

**Table 1.**

*Acrophobia Questionnaire blueprint*

| Aspect | Favourable | Total |
|---|---|---|
| Anxiety | 1-20 | 20 |
| Avoidance | 21-40 | 20 |

The state-trait anxiety inventory (STAI) was developed by Spielberger et al. (1983) to reveal or assess anxiety symptoms in individuals. This scale has 20 items that assess current anxiety and 20 items that assess trait anxiety. Only the subscale that measures the trait condition was used in this study. This scale's response options range from 1 (extremely not anxious) to 4 (very anxious). This scale is now available in Indonesian. The

coefficient of $\alpha = 0.920$, $\alpha > 0.5$ is known based on the results of the scale test to 106 respondents, while the content validity coefficient is 0.921 based on the rating results of 10 professional psychology students in the clinical sector. The STAI blueprint can be seen in table 2 below.

**Table 2.**

*State-Trait Anxiety Inventories blueprint*

| Aspect | Favourable | Unfavourable | Total |
|---|---|---|---|
| State Anxiety | 3, 4, 6, 7, 9, 12, 13, 14, 17, 18, | 1, 2, 5, 8, 10, 11, 15, 16, 19, 20 | 20 |

Mandler et al. (1958) created the automatic perception questionnaire (APQ). This scale is made up of 24 graphic scale items, each of which is related to the perception of bodily activity. This scale item addresses seven different aspects of the body's reaction: heart rate, sweating, temperature fluctuations, respiration, indigestion, muscle tension, and blood pressure. The scale is divided into six equal intervals, and participants are asked to rate each item on a range of one to seven. The coefficient of $\alpha = 0.960$, $\alpha > 0.5$, is known from a test of 106 respondents. The content validity coefficient is 0.835, based on the ratings supplied by 13 raters, including 4 doctors and 9 students of professional psychology in the clinical field.

*Research procedure*

The technique for performing this research began with administering AQ to the participants as a pre-test and screening. Participants who meet the criteria and are assigned to the experimental group are then scheduled to attend 9 therapy sessions. Participants were briefed and given a general summary of the treatment that would be offered in subsequent sessions during the first session. As a form of follow-up examination, the therapist additionally requested some information about the individuals relevant to their acrophobia. Participants were also given breathing relaxation exercises during this session. The class concluded with an assignment to do relaxation at home.

The therapist reviews the assignments given in the second session. The therapist then explains the session agenda during the meeting. Next, the therapist and the participants addressed the usual reactions experienced by people when faced with a height stimulus. The therapist then goes through the mechanism of action of exposure therapy and why it is used. Participants have also been exposed to the STAI and APQ measures before being asked to work on them as a baseline measurement. Participants in this session were also given assignments.

The VRET treatment was administered to the participants during the third session. Participants were requested to stand on a pedestal that was outfitted with a handrail to aid participants in holding on. Participants had their heart rate, breathing, and skin

conductance measured using a biofeedback meter connected to the Biograph. Participants were also given VR cameras to display height stimuli and headphones to offer sound stimuli for them to feel fully immersed in the desired environment. Participants saw themselves in an elevator and then gently went up to a higher floor of a skyscraper via a VR camera. Participants can then see that they are on the floor of a building high enough to observe other lower-level buildings. Participants were advised to pay attention to their surroundings. Following that, participants were requested to walk on a board that was hung in the building. The therapist gives instructions to the participants during the treatment.

Physiological reactions are also monitored for roughly 20 seconds during exposure. The data recording process was carried out in eight situations: 1) before putting on the VR camera and headset; 2) after installing the VR camera and headset, participants can see themselves in an elevator; 3) when participants arrive at the 3rd floor of the building; 4) after the participants explore the height environment from the 3rd floor of the building; 5) when participants arrive at the 10th floor of the building; 6) after the participants explore the height environment from the 10th floor of the building; 7) after the participants walk on the hanging board and pick up the object that is on the board; 8) after the VR camera and Headset are removed.

After the experiment was conducted, participants were asked to fill out the STAI and APQ scales. The session closed by giving reassignments to participants. Similar procedures were also performed in sessions four, five, six, seven, and eight by combining additional treatments such as relaxation. In each exposure session, participants reach different stages depending on the participants' readiness. During the exposure process, participants are expected to be able to practice relaxation techniques independently even though they will also be reminded by the therapist. In session six before the exposure procedure, the therapist reviewed the results of the participants' biofeedback measurements during the last three sessions.

The therapist held a termination session in session nine. The therapist reviewed the entire treatment procedure and solicited comments from participants. The therapist also went over the participants' biofeedback measurements. The therapist requested participants to fill out the AQ as a post-test to see if their level of acrophobia has changed. Following that, the therapist and participants addressed relapse prevention strategies. Each participant receives an incentive in the form of IDR 25,000.00 in cash (sessions 1-9) at the end of each therapy session and a booklet at the end of the session nine.

*Data analysis*

Data analysis was carried out by comparing the results of the pretest and posttest AQ Anxiety and Avoidance between the control group and the experimental group using the Repeated Measures ANOVA method. The data obtained from the scale were analyzed using IBM SPSS (Statistical Package for the Social Science) Statistics version 20.

# Results

This study aimed to see whether the VRET module is effective in reducing the symptoms of acrophobia. Data analysis was performed by comparing the pre-test and post-test AQ-Anxiety and AQ-Avoidance between the control and experimental groups using Repeated Measures ANOVA.

**Table 3.**

*Repeated Measures ANOVA Influenced of VRET to Acrophobia Symptoms*

| Variable | Control Group (*n*=14) | | Experimental Group (*n*=15) | | ANOVA | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *F* | $\eta^2$ |
| **AQ-Anxiety** | | | | | | |
| Pre-test | 66.86 | 12.60 | 71.53 | 13.48 | 54.24** | 0.67 |
| Post-test | 65.79 | 15.72 | 21.93 | 14.05 | | |
| **AQ-Avoidance** | | | | | | |
| Pre-test | 13.29 | 3.56 | 14.00 | 5.83 | 35.22** | 0.57 |
| Post-test | 14.00 | 6.08 | 2.47 | 2.07 | | |

**Note.** [AQ]Acrophobia Questionnaire **$p < .05$

Based on the results of the analysis showed that there was a significant effect on the symptoms of acrophobia between the control and experimental groups on the pre-test and post-test measurements with $F(2, 26) = 27.98$, $p < .01$, $\eta^2 = .68$. This demonstrates that VRET affects reducing acrophobia symptoms in people who have this inclination. According to the results of the test, VRET has an influence on the AQ-Anxiety subscale, $F(1, 27) = 54.24$, $p < .01$, $\eta^2 = .67$ and the AQ-Avoidance subscale,, $F(1, 27) = 35.22$, $p < .01$, $\eta^2 = .57$.

A follow-up procedure was also performed on the experimental group participants one month after the VRET therapy to assess the stability of the treatment's impact. After one month of treatment, a statistical analysis utilizing repeated measures ANOVA was done to examine if there were any changes in acrophobia symptoms.

**Table 4.**

*Repeated Measures ANOVA Changes in Symptoms of Acrophobia Pre-test and Follow-up*

| Variable | Experimental Group (*n*=15) | | ANOVA | |
|---|---|---|---|---|
| | *M* | *SD* | *F* | *Sig.* |
| AQ-*Anxiety* | | | | |
| Post-test | 21.93 | 14.05 | 3.14 | .098 |
| Follow-up | 16.93 | 9.71 | | |
| AQ-*Avoidance* | | | | |
| Post-test | 2.46 | 2.07 | 1.86 | .195 |
| Follow-up | 1.67 | 1.88 | | |

**Note.** [AQ]Acrophobia Questionnaire

According to this analysis, there was no difference in acrophobia symptoms between post-test and follow-up assessments $F(2, 13) = 1.78$, $p > .05$. Similarly, there was no significant difference between the post-test and follow-up measurements on the AQ-Anxiety subscale, $F(1, 14) = 3.14$, $p > .05$, and $F(1, 14) = 1.86$, $p > .05$, on the AQ-Avoidance subscale. It can be inferred that acrophobia symptoms in experimental group participants tended to remain stable after 1 month of VRET treatment.

*Psychological Indicators*

The experimental group participants were also requested to complete the STAI and APQ scales as a pre-test and post-test (in sessions 2 and 9). In addition, participants were asked to fill out the scale after each exposure session (sessions 3 to 8). This was done so that participants' progress from the session to session could be tracked more thoroughly. The researchers used Repeated Measures ANOVA to determine the difference in pre and post-scores on the two measuring devices, as shown in Table 5.

**Table 5.**

*Repeated Measures ANOVA of STAI and APQ Measurements Pre-test and Post-test*

| Variable | Experimental Group (*n*=15) | | ANOVA | |
|---|---|---|---|---|
| | *M* | *SD* | *F* | *η²* |
| STAI | | | | |
| Pre-test | 65.87 | 9.94 | 41.61** | .75 |
| Post-test | 35.27 | 11.31 | | |
| APQ | | | | |
| Pre-test | 115.80 | 19.68 | 82.86** | .86 |
| Post-test | 55.13 | 22.33 | | |

**Note.** [STAI]State-trait Anxiety Inventory; [APQ]Autonomic Perception Questionnaire; **$p < .01$

Based on the analysis showed that in the experimental group there was a significant difference between the pre and post-scores on the STAI scale, $F(1, 14) = 41.61$, $p <.01$, $\eta^2 = .75$, and also on the APQ, $F(1, 14) = 82.86$, $p <.01$, $\eta^2 = .86$. The results of both scales revealed a significant drop in post-intervention score after delivery of the VRET intervention. This suggests that participants in the experimental group reported less anxiety than they did before the intervention. Furthermore, participants reported no significant changes in physiological reactivity following the intervention when asked to envision the height position they were scared of.

STAI and APQ measurements were also performed as long as participants completed the exposure stage in six sessions (sessions three through eight), thus the researchers used repeated measures tests to observe how the pattern altered. According to the repeated measures test, the experimental group had substantial changes in STAI and APQ scores in each exposure session, as shown in Table 6.
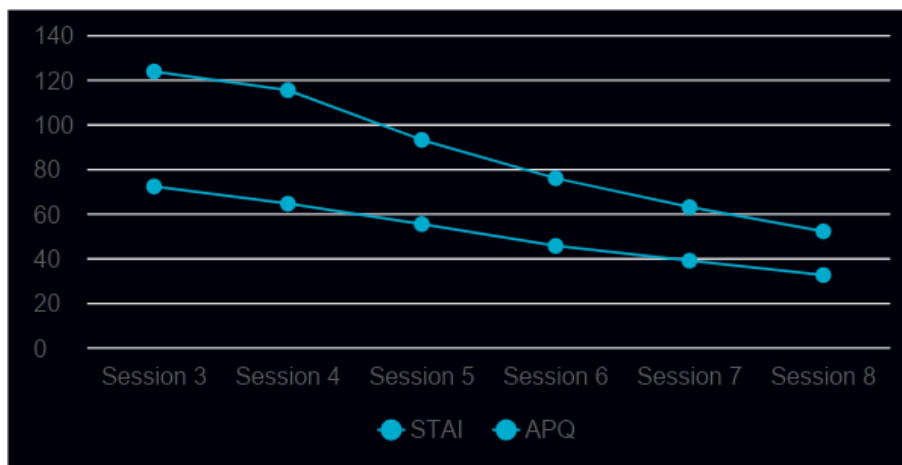
**Table 6.**

*Repeated Measures ANOVA STAI and APQ*

| Variable | Factor | Mean Square | ANOVA | |
|----------|--------|-------------|-------|-------|
| | | | $F$ | $\eta^2$ |
| STAI | Session 3-8 | 3501.32 | 82.46** | .85 |
| APQ | | 33318.10 | 46.25** | .77 |

**Note.** [STAI]State-trait Anxiety Inventory; [APQ]Autonomic Perception Questionnaire; **$p < .01$

From session three through session eight, the two scales exhibit a progressive fall in scores as shown in Figure 5. This demonstrates that exposure can lessen anxiety and the perception of physiological responses in people suffering from acrophobia.

**Figure 5.**

*STAI and APA Score Changes*



**Note.** [STAI]State-trait Anxiety Inventory; [APQ]Autonomic Perception Questionnaire

*Physiological Indicators*

Using repeated measures ANOVA analysis, the researcher observed changes in physiological indicators that occurred in sessions 3 to 8 for each measurement stage, as shown in Table 8.

**Table 8.**

*HR, RR, and SC Repeated Measures ANOVA*

| Variable | Factor | Mean Square | ANOVA | |
|---|---|---|---|---|
| | | | *F* | *η²* |
| Heart Rate (HR) | | | | |
| Measurement 6 | | 72.72 | .90 | .06 |
| Measurement 5 | | 192.7 | .07 | .13 |
| Measurement 4 | | 58.07 | .73 | .05 |
| Measurement 3 | | 242.48 | 1.18 | .08 |
| Respiratory Rate (RR) | | | | |
| Measurement 6 | | 8.82 | 1.18 | .08 |
| Measurement 5 | Session (3-8) | 13.01 | 2.26 | .14 |
| Measurement 4 | | 22.47 | 3.65* | .21 |
| Measurement 3 | | 8.31 | 1.21 | .08 |
| Skin Conductance (SC) | | | | |
| Measurement 6 | | 6.94 | 2.37 | .15 |
| Measurement 5 | | 10.14 | 3.24* | .18 |
| Measurement 4 | | 5.30 | 3.02* | .18 |
| Measurement 3 | | 10.26 | 4.42** | .24 |

**Note.** *$p < .05$ **$p < .01$

According to the findings of the analysis, there was a significant decrease in physiological indicators in measurement 5 (up to the 10th level) from sessions 3 to 8, $F(15, 210) = 2.29$, $p <.01$, which was indicated by the SC indicator. On measurement 4 (exploratory floor 3) there was also a significant decrease in physiological reactions where $F(15, 210) = 2.34$, $p <.01$, which was indicated by the RR and SC indicators. In measurement 3 (up to the 3rd floor), participants' physiological reactions also showed a significant decrease with $F(15, 210) = 2.15$, $p <.01$, as indicated by the SC indicator. While on measurement 6 (exploration on the 10th floor) there was no significant change in the participants' physiological indicators, $F(15, 210) = 1.39$, $p >.05$.

Based on the findings of the physiological indicator analysis, it is possible to conclude that the VRET treatment can reduce anxiety in the experimental group participants. This is seen by a significant drop in SC physiological markers across practically all measurement stages from sessions 3 to 8, as well as RR throughout one

measurement stage from sessions 3 to 8. However, HR markers indicate no significant changes across all measurement stages.

## Discussion

The purpose of this study was to determine whether the VRET module is effective in reducing acrophobia symptoms. The researcher used the Aiken's V technique for content validation, asking 5 raters to submit an assessment, and functional validation through an experimental process administered to 15 people in the experimental group.

According to the content validation results, the VRET module has good content validity. The coefficient V score of 0.8-1 on all items examined demonstrates this. A content validity value of 0.80 or higher, according to Rubio et al. (2003), is regarded as a very good indicator of content validity. This means that the conformity of the content of the module with the objectives to be achieved is good.

This study also included functional validation with 29 participants divided into control and experimental groups. According to the findings of the analysis, there are substantial differences in AQ-Anxiety and AQ-Avoidance between the control and experimental groups following the VRET treatment. This suggests that the VRET module works to alleviate acrophobia symptoms. The findings of this study are consistent with those of Abdullah and Shaikh (2018), who found that an 8-session Virtual Reality Exposure treatment was successful in lowering anxiety in 10 people suffering from acrophobia. The same study discovered that VRE therapy outperformed in vivo exposure.

Other studies have found that psychological treatment utilizing virtual reality can lessen acrophobia symptoms in persons with a fear of heights, as indicated by an acrophobia questionnaire (Freeman et al., 2018). Other findings in this study revealed that participants reported a decrease in components of anxiety and perceptions of physiological reactions connected to altitude circumstances, in addition to a decrease in acrophobia symptoms.

From session 3 to session 8, the scores on these two characteristics significantly decreased. This procedure demonstrated that participants were becoming accustomed to the 3D virtual environment situation offered. This habituation process is also known as habituation. The base that can explain the changes that occur in the experimental group members is habituation. According to the behavioral approach model, habituation happens when there is organized contact with the feared stimuli during the exposure period, which reduces the possibility to evade or escape (Benito & Walther, 2015). Its goal is to lessen anxiety by making touch with the stimulus.

In the habituation process, behavioral changes can be seen through various mechanisms such as neural mechanisms (Hauner et al., 2012), cognitive changes (Solem et al., 2009), and learning mechanisms (Anderson & Insel, 2006). The most crucial aspect of

the exposure technique that must be included for this habituation process to occur is the fear activation phase (Benito & Walther, 2015).

Fear activation must be relevant to the individual's experience and involve relevant stimuli (in this case an altitude situation), which must cause a fear response both subjectively and physiological changes (Benito & Walther, 2015). It is demonstrated in this study by measuring STAI, APQ, HR, RR, and SC indicators. Fear activation in general can be recognized by searching for the highest score of psychophysiological tests in the first session of exposure (Craske et al., 2008). This is consistent with the findings of this study, which revealed that the greatest STAI and APQ scores were obtained during the first exposure session. When compared to subsequent exposure sessions, the RR and SC scores appeared to be the highest in the first exposure session.

This is also corroborated by the findings of a study conducted by Diemer et al. (2016), which found that exposure to virtual media can increase anxiety in people suffering from acrophobia. According to this study, in addition to psychological evaluations indicating that participants are very nervous at the time of the first session exposure, physiological reactions are indicating that participants' anxiety is increased. The skin conductance indicator demonstrates a rise in sweat gland activation at each stage of exposure, with stage 7 (taking a cat) showing a fairly large increase.

The decrease in participants' assessments of their anxiety conditions and physiological reactions was supported by biofeedback measurements, which revealed a considerable decrease, particularly for the SC and RR markers. This is consistent with the findings of a study conducted by Costa et al. (2016), which found that high skin conductance is associated with increased anxiety in individuals suffering from acrophobia during the exposure process, so a decrease in the SC indicator also indicates a decrease in the anxiety felt by participants.

This is also consistent with the findings of Rosebrock et al. (2017), who discovered a strong link between increasing anxiety and SC scores in anxiety-stimulated adults. On the other hand, as the participant's anxiety level fell, there was a substantial fall in SC ratings (Rosebrock et al., 2017). This demonstrates that SC can represent anxious conditions that people feel.

HR markers do not show changes in physiological response. This is consistent with the findings of (De Jong et al., 2004), who found that anxiety was not substantially related to an increase in heart rate. This is because anxious people do not have a homogenous rise in heart rate response. Furthermore, Phelps and LeDoux (2005) claimed that HR is more generally utilized as an indicator in the stress literature, but SC is more commonly used as an indicator in anxiety research.

This study's virtual environment employs a gradual sort of exposure. This suggests that participants choose less terrifying height scenarios to circumstances that cause them to worry. Participants can handle their anxiety in a more regulated and structured manner with this method (Donker et al., 2018).

## Conclusion

According to the findings of this study, VRET is effective in reducing the symptoms of acrophobia. This is evidenced by fewer symptoms and a decrease in psychological and physiological indicators. Continuous and structured exposure to altitude stimuli via VR media in the experimental group was able to reduce anxiety associated with altitude situations. This decrease in anxiety was supported by a significant decrease in the SC and RR indicators.

*Limitations*

The limitation of this study is the small number of participants (29 in this case). The altitude environment employed is likewise limited so that the tasks required in each exposure session are always the same.

*Suggestion*

Researchers who intend to replicate this study or conduct further research on its usefulness might consider increasing the number of participants in this study. They can also create virtual environment settings to be displayed. The next researcher can add more tasks for the participants and improve the design of the virtual environment.

## Declaration

*Authors' Contribution*

FA was accompanied by NR in compiling the research design, conducting data collection, and conducting data analysis. The FA together with MSU reviewed, adapted and approved the final manuscript.

*Conflict of Interest*

The authors declare no conflict of interest in the research and writing of this published article.

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