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Research paper

Emotional and Cognitive Impact of Virtual Patient Simulation on Medical Students in The GCC: A Mixed-Methods Study

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Abstract

This study investigates the emotional and cognitive transformations of medical students engaged in Body Interact Virtual Patient Simulation (VPS) at Arabian Gulf University, Bahrain. This study utilizes a mixed-methods approach comprising pre/post surveys (N=35), tutor observations, and audio transcript analysis to investigate the progression from initial stress and diagnostic uncertainty to improved confidence and clinical assurance. Quantitative results demonstrated statistically significant improvements in flow (Q12: p = 0.0069, d = 0.69) and moderate enhancements in enjoyment and perceived absorption (Table 4.1). Emotional peaks, particularly fear and hesitation during Session 2, were documented through NRC sentiment analysis (Figure 4.4) and thematic audio coding (Table 4.6), while confidence steadily increased across Sessions 4 and 5.

A novel theoretical framework, the Dual-Phase Stress Adaptation Theory, was established through grounded theory analysis (Figure 4.5), clarifying the phased transition from stress to confidence through scaffolded repetition and social feedback. The model was quantitatively supported by OSCE performance correlations (r = 0.73, Table 4.11) and effect sizes associated with clinical decision-making (d = 1.33).

A predictive performance model delineates the trajectory of learning: Performance = 0.71(Tolerance) − 0.33(Acute Stress) + 0.40(Team Sup-port) − 0.15(Technical Issues) (Equation 6.9, p. 250).

The findings validate VPS as a cognitive enhancer and emotional support system in medical education, particularly in GCC contexts where data on VPS is scarce. The results of this investigation demonstrate that structured simulation can improve diagnostic reasoning, enhance confidence, and alleviate tension when implemented according to psychologically responsive design principles.

Keywords: *Virtual Patient Simulation; Stress; Confidence; Clinical Decision-Making; Medical Education; Mixed Methods; Grounded Theory; GCC.*

1. Introduction

Virtual simulation technologies swiftly revolutionize clinical education by enabling students to participate in authentic decision-making without jeopardizing patient safety. Although much research has emphasized advancements in skill development, there has been comparatively little focus on the emotional and cognitive reactions experienced by students during simulations. This is especially under-researched in Gulf Cooperation Council (GCC) nations. Incorporating Body Interact VPS into AGU's medical curriculum in Bahrain offers a chance to examine the transition of tension and reluctance into clinical confidence [1], [2].

Medical trainees often experience cognitive overload and emotional anxiety during actual patient interactions, which may impede their learning efficacy and impact their future confidence. Simulation offers a regulated setting to provide students with analogous issues while ensuring patient safety is not jeopardized [3], [4]. VPS is an invention that offers high fidelity, interactive patient scenarios to assess diagnostic, procedural, and decision-making abilities under duress. [5] assert that core clinical education includes communication, critical thinking, and basic sciences, all reinforced by VPS in secure, repeatable forms [6].

Enhancing clinical reasoning techniques is crucial for diagnostic and therapeutic decision-making. VPS does this by rectifying knowledge gaps and improving error reduction via experiential learning [7], [8]. Medical decision-making is a complex cognitive process shaped by biases and clinical contexts, with technologies like VPS offering a unique platform for creating, reflecting, and improving these reasoning processes. This research analyses the emotional and cognitive transformations recorded between Sessions 1 and 6.

Notwithstanding the focus on clinical reasoning in education, its assessment is often limited, especially in emotional tension or uncertainty contexts. Argumentation-based learning promotes critical engagement with clinical concepts and bolsters learner confidence through methodical exploration [9-17]. This method allows learners to address uncertainty positively, reducing anxiety and improving resilience.
Medical education, shaped by psychology, ethics, and sociology, is evolving from passive lectures to active, experiential learning settings. These facilitate long-term memory development, autonomy, and crucially, self-efficacy confidence in one's capacity to use information in high-pressure circumstances [18].
Problem-Based Learning (PBL), Case-Based Learning (CBL), and Team-Based Learning (TBL) are crucial for cultivating competence and confidence via collaborative, student-led problem-solving. These immersive techniques allow students to analyze decision-making in genuine stress scenarios, enhancing their capacity to withstand ambiguity and pressure [19-23].
Furthermore, the COVID-19 epidemic expedited the use of simulation and virtual learning systems, supplanting conventional bedside instruction with digital resources. Numerous studies [24-29] highlight the advantages and constraints of online medical education. Virtual patient systems, especially Body Interact, have developed to replicate diagnostic reasoning and clinical empathy in low-risk settings [30], [31]. This research, set within that geographical and technical framework, aims to comprehensively assess the impact of VPS on the emotional and cognitive development of medical students in Bahrain.
Virtual Patients (VPs) are computer programs designed to simulate real clinical environments, serving as practical tools for practicing clinical scenarios in a low-stress and psychologically safe context. Simulations enable learners to evaluate performance, extract lessons from errors, and build confidence without risking harm to actual patients [32]. They effectively reduce performance anxiety, promote self-reflection, and enhance emotional preparedness in learners.
Simulation-Based Medical Education (SBME) is crucial for developing technical skills and enhancing students' confidence in high-pressure scenarios. Simulating empathy poses challenges compared to fundamental patient interactions; nonetheless, the psychological safety of virtual patients aids in cultivating emotional regulation and stress tolerance in learners. A controlled learning environment improves confidence and diminishes anxiety in early clinical decision-making experiences [33-41].
VPs effectively enhance clinical reasoning in high-pressure situations by fostering confidence and resilience. There is a lack of systematic evaluation of VPS tools concerning their effects on learner stress levels and confidence enhancement. This review aims to address the existing gap by synthesizing the available evidence on the impact of VPS on stress tolerance and learner confidence [38], [42-51].
This study investigates the emotional progression of learners using VPS by examining the following research question: What is the process by which medical students go from initial concern to confidence when using Body Interact? This study employs a mixed-methods approach, including quantitative survey analysis (Table 4.1), qualitative thematic coding of audio-tutor logs, and grounded theory construction underpinned by triangulated evidence (Table 4.9).

2. Literature Review

Several global studies have investigated the educational efficacy of Virtual Patient Simulation (VPS) in enhancing clinical reasoning and cognitive skill development. [5], assert that VPS facilitates the development of diagnostic thinking among medical students within a safe and regulated setting. Their thorough evaluations indicated that VPS improves decision-making capacity and therapeutic involvement [32]. The findings correspond with the study's data, which indicated heightened cognitive absorption reflected in post-survey engagement scores (Figure 4.1) and were additionally substantiated by qualitative data from audio transcripts and tutor observations highlighting confidence improvements and immersive behavior, particularly noticeable in Sessions 4 and 5.

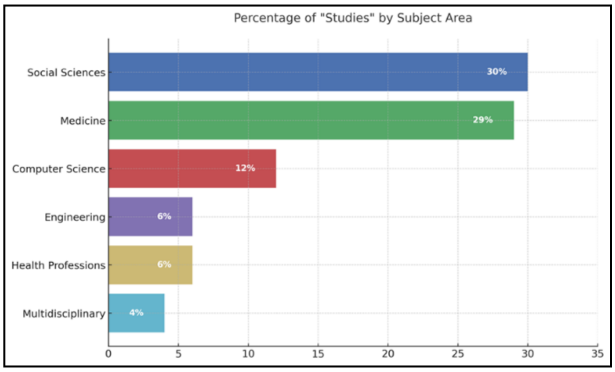

Fig.1: Studies by Subject Area (Virtual Patient Simulations on Medical Students' Learning Outcomes). Includes an "Unidentified" Category (18%), Representing Studies That Did Not Clearly Specify A Discipline, Limiting Interpretability.

Figure 2.1 summarizes the distribution of studies examining the efficacy of virtual patient simulations (VPS) on medical students' learning outcomes. The pie chart indicates that research on VPS in specific disciplines tends to concentrate in certain areas. A substantial percentage (29%) is attributed to Biochemistry, Genetics, and Molecular Biology, highlighting a focus on the effectiveness of VPS in knowledge acquisition within these fields. Categories such as Decision Sciences (12%) and Nursing (6%) indicate that VPS is being explored across disciplines beyond the life sciences, raising essential questions about how VPS can be adapted for diverse educational objectives.
A notable 18% of studies fell into an "unidentified" category, representing research that did not clearly align with a specific discipline or spanned multiple domains. This lack of classification reduces the clarity of the evidence base and makes it difficult to map how VPS is being applied across medical and allied health curricula. Standardizing how VPS research is categorized would help future studies accurately capture the full scope of applications.
Beyond these distributions, [44] and [45] reported that regular exposure to virtual simulations reduces learner anxiety and promotes self-regulated learning. In the present study, this was reflected in statistically significant improvements in Q12–Q14 (engagement and attention), as shown in Table 4.1. These findings were corroborated by instructor observations and audio analysis, highlighting enhanced reflective practice and group cooperation. Similarly, [49] found that VPS improved diagnostic accuracy and reflective practice, particularly when combined with structured debriefing. These outcomes were thematically captured in the present study through codes such as "team debriefing," supported by post-simulation logs and participant comments.

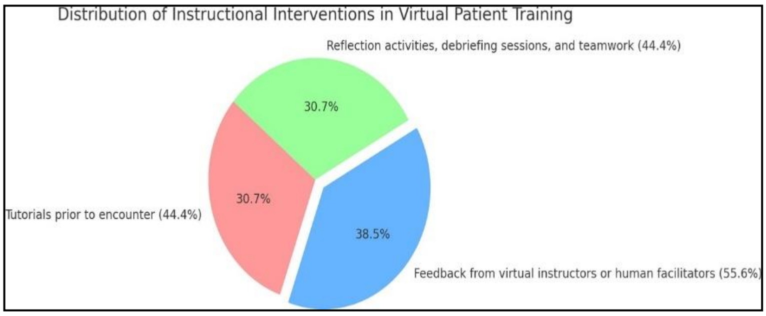

Fig.2: Distribution of Instructional Interventions in Virtual Patient Training.

Figure 2.2 indicates a scatterplot that depicts the instructional interventions utilized in Virtual Patient (VP) training across 18 studies. The tutorial was employed in 44.4% of the studies, mainly for pre-VP interactions. In 55.6% of the cases, feedback from virtual instructors or human facilitators was utilized, whereas 44.4% of the studies incorporated reflection activities, debriefing sessions, or teamwork practices [52]. The interventions aim to improve learning performance by incorporating self-reflection, timely feedback, and reviewing key concepts to achieve comprehensive and practical training outcomes [53].

Subsequent research by [46], [50] confirmed that VPS augments student autonomy and clinical confidence, which are essential emotional outcomes shown in this thesis. The favorable correlation between simulation exposure and OSCE performance (r = 0.73), as shown in the thesis analysis, substantiates these assertions. Concurrently, researchers such as [42], [51] emphasized the importance of regional and cultural adaptation in simulation-based learning. This study addresses the gap by presenting data from the Arabian Gulf University in Bahrain about enhancing cognitive and emotional learning outcomes in medical education using VPS.

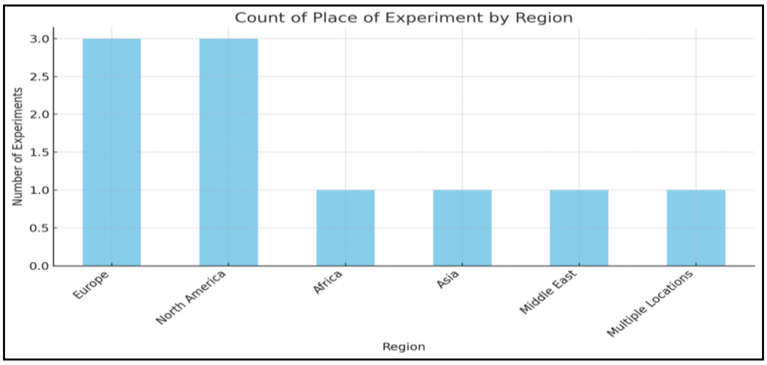

Fig.3: Places of Experiment. Highlights the Use of VPS Across Different Learning Environments, Reflecting How Setting Influences Learner Preparedness and Clinical Competence.

The relationship between emotional preparedness and clinical competence is well established. According to Bandura (1997), self-efficacy is a vital determinant shaping learners' strategies in complex problem-solving. This concept has been widely applied in simulation literature to explain how recurrent clinical exposure bolsters confidence and reduces anxiety. In the current study, multiple VPS sessions demonstrated the relevance of Bandura's paradigm: scaffolded repetition, authentic clinical scenarios, and prompt feedback allowed learners to achieve incremental mastery and transfer skills more effectively. Importantly, the settings in which these simulations occurred also shaped learner outcomes. Students reported higher confidence and motivation in structured, supervised environments compared to more isolated settings, suggesting that context plays a significant role in maximizing the benefits of VPS. This highlights the need for future studies to evaluate how place and setting influence both cognitive and emotional dimensions of simulation-based learning.

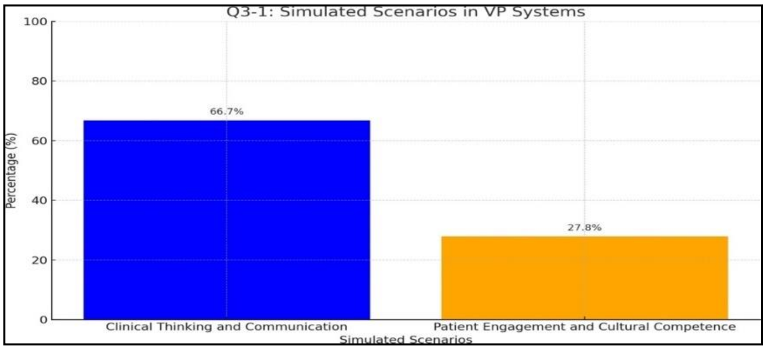

Fig.4: Simulated Scenarios in VP Systems Focus on Clinical Thinking, Communication, and Cultural Competence.

Figure 2.4 illustrates the main simulation cases analyzed through Virtual Patients. Research data indicate that Clinical Thinking and Communication scenarios constitute 66.7% of all simulated cases, underscoring their significance in medical patient care [54]. Patient engagement and cultural competence constitute 27.8% of scenarios simulated through virtual patient systems, indicating their increasing educational significance Saniya Raghib Sabzwari1, 2023). General Practitioner systems fulfil two essential functions: improving clinical competencies and interpersonal skills, highlighting the need for customized Gulf Cooperation Council contexts to advance patient education software.

Meichenbaum's (2007) Stress Inoculation Theory also endorses the graduated exposure approach in simulation-based learning. The hypothesis asserts that emotional resilience may be developed by incremental exposure to stress-inducing events, accompanied by cognitive restructuring. This theoretical model roughly aligns with the outcomes of this study: Session 2 demonstrated the most pronounced indicators of dread and reluctance, as shown by sentiment analysis and NRC lexicon results (Figure 4.1), but qualitative analysis of Sessions 4 and 5 indicated improved flexibility and less anxiety.

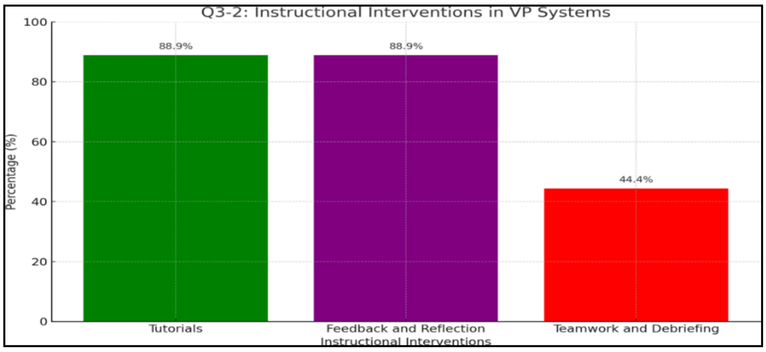

Fig.5: Instructional Interventions Used in VP Training Go Beyond Clinical Reasoning.

Figure 2.5 demonstrates the improvement in VP training results. The implementation rates demonstrate that Tutorials and Feedback/Reflection exceed 88.9% [56]. Students achieve training objectives by engaging in tutorials, and feedback and reflection sessions improve their critical thinking and self-analysis skills. The staff development method, Teamwork and Debriefing, improves collaboration within healthcare teams, as demonstrated by its use in 44.4% of educational cases [53]. VP systems utilize educational strategies that extend beyond medical reasoning components to create team-oriented curricula and promote students' self-evaluation processes.

Flow Theory, articulated by Csikszentmihalyi (1990), deepens the comprehension of learner engagement in simulation environments. This study documented a substantial increase in flow state indicators, particularly in Q12 responses (time distortion and deep engagement), which were statistically significant as seen in Table 4.1. The quantitative trends were evident in audio transcript excerpts, as shown by the student's remark: “I didn’t notice time passing; we were so focused.” Improvements in confidence were validated by performance metrics in OSCE scores (Table 4.11).

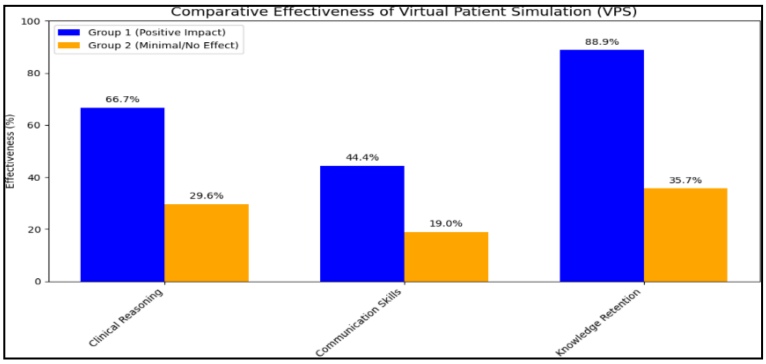

Fig.6: Summary of VPS Effectiveness.

Figure 2.6 presents Virtual Patient Simulation (VPS) performance metrics in three essential skill domains. Clinical reasoning, communication skills, and knowledge retention constitute fundamental elements in the healthcare domain. The findings from Group 1 revealed positive VPS results, showing better outcomes in all skill areas than Group 2, which displayed minimal or negligible VPS effects. Research shows that Group 1 VPS attained an effectiveness rate of 66.7% in Clinical Reasoning, while Group 2 studies exhibited a mere 29.6% success rate with this approach. Group 1 showed a 44.4% improvement in communication skills, while Group 2 showed a mere 19% improvement. The outcomes of knowledge retention from VPS training were significant, with Group 1 achieving an effectiveness of 88.9%, while Group 2 attained only 35.7%. VPS is a valuable training resource that enhances practical clinical skills, supplementing conventional educational approaches to promote interactive learning experiences.

Collectively, these frameworks support and authenticate the Dual-Phase Stress Adaptation Theory established in this thesis (Figure 4.5). This theory elucidates how stress functions as a disruptive force (activation phase). Still, when coupled with systematic repetition and team feedback, it evolves into a catalyst for confidence and performance (consolidation phase). The model is based on mixed-method triangulation: survey trends, sentiment indicators, and observed actions, showing that VPS is both a cognitive enhancer and an emotional support system that aids the transition from anxiety to confidence. Despite the promising findings, prior research reveals several limitations that restrict the generalizability of VPS outcomes. Many studies relied on relatively small or homogeneous samples, limiting external validity ([58], [59]). Moreover, short-term evaluation designs dominate the literature, making it difficult to determine whether the benefits of VPS persist over time. A further gap is the scarcity of studies contextualized to the GCC region, where cultural and linguistic factors may significantly shape learner engagement and outcomes. The present study aims to contribute a more contextually relevant and methodologically robust analysis by addressing these limitations.

3. Methodology

3.1. Research Design

This research used a convergent mixed-methods methodology, amalgamating quantitative and qualitative data from Virtual Patient Simulation (VPS) sessions at Arabian Gulf University. The main objective was to investigate medical students' emotional and cognitive development via repeated simulation exposure. Quantitative data were obtained by pre- and post-intervention questionnaires (N=35) with Likertscale questions addressing stress, confidence, and attention (Questions Q12–Q18). The corresponding findings are shown in Table 4.1. The survey results were subjected to statistical analysis by paired t-tests and MANOVA.

Qualitative data sources included tutor observation logs (n=6), audio recordings of student interactions during simulations (n=5), and post-session student feedback. The data was analyzed using grounded theory employing open and axial coding, resulting in the discovery of key categories such as "stress activation," "confidence growth," and "team debriefing." Fifty-three unique emotional indicators were classified and used to verify the model shown in Figure 4.5.

3.2. Participants and Setting

Thirty-five fifth-year medical students from AGU engaged in VPS sessions focused on pediatric asthma. The sessions used Body Interact software. Each session lasted 30 minutes and was followed by a collaborative debriefing. Participants were assigned to simulation teams of two to facilitate peer learning and collaborative clinical reasoning. AGU’s Institutional Review Board secured ethical approval, and all participants provided informed consent. Anonymity and confidentiality were preserved throughout the data collection process.

3.3. Theoretical Frameworks and Integration

This study was guided by three interrelated frameworks for its design and analysis. Bandura’s Social Cognitive Theory first outlined the development of self-efficacy and mastery via repeated exposure and vicarious learning. Secondly, Meichenbaum’s Stress Inoculation Theory clarifies how emotional distress is transformed into cognitive resilience during the simulation arc, especially when comparing initial fear responses (Session 2, Figure 4.1) with the confidence patterns observed in Sessions 4 and 5.

Third, Csikszentmihalyi’s Flow Theory clarified the students’ deep engagement and cognitive investment throughout the simulation. Elevated Q12 responses (engagement/flow) and assertions such as “we were so focused” substantiate the association between emotional state and learning efficacy (Table 4.1). The three frameworks directly impacted the Dual-Phase Stress Adaptation Theory formulation, shown in Figure 4.5, which was validated by survey and coded transcript data.

4. Results

4.1. Quantitative Findings

The statistical analysis of the pre- and post-intervention questionnaires indicated significant improvements in student engagement and slight increases in confidence. Table 4.1 shows that Q12 (Time Flow) increased from a pre-intervention mean of 3.96 to 4.59 post-intervention ($p = 0.0069$, $d = 0.69$), suggesting enhanced concentration and engagement during simulations. Q13 (Enjoyment) increased from 4.44 to 4.81 ($p = 0.0571$), while Q14 (Absorption) showed a slight increase from 4.63 to 4.81 ($p = 0.2590$), with moderate and small effect sizes, respectively. Stress-related measures (Q16–Q18) showed minor increases, interpreted not as detrimental anxiety but as advantageous arousal that enhances learning.

Table.1: Paired T-Test Results for Flow, Stress, and Confidence Survey Questions

Question	PRE-MEAN	POST MEAN	MEAN DIFF	T-STAT	P-VALUE	COHEN’S D
Q12	3.96	4.59	+0.63	-2.94	0.0069	0.69 (MODERATE-HIGH)
Q13	4.44	4.81	+0.37	-1.99	0.0571	0.54 (MODERATE)
Q14	4.63	4.81	+0.19	-1.15	0.2590	0.30 (SMALL)
Q15	4.56	4.67	+0.11	-0.59	0.5585	0.16 (SMALL)
Q16	3.26	3.63	+0.37	-0.73	0.4690	0.25 (SMALL)
Q17	3.33	3.11	-0.22	0.46	0.6482	-0.14 (NEGLIGIBLE)
Q18	2.96	3.04	+0.07	-0.13	0.8938	0.05 (NEGLIGIBLE)

Table 4.1 presents the means for survey items Q12–Q18, which evaluate flow (engagement), stress, and simulation-related anxiety before and after the intervention. Q12 (“time perception”) showed a statistically significant improvement ($p = 0.0069$) with a moderate-to-large effect size ($d = 0.69$), indicating enhanced cognitive immersion during VPS. Moderate increases in enjoyment (Q13) and absorption (Q14) were observed. Items associated with stress (Q16–Q18) demonstrated minimal or insignificant changes, suggesting emotional adaptation while underscoring persistent anxiety indicators. The table presents quantitative evidence supporting the Dual-Phase Stress Adaptation Theory, showing a progressive increase in engagement over time.

Further analysis of pre–post differences is included in Table 4.2. Q12 exhibited a mean enhancement of +0.578 in time perception, while Q16 (stress) rose by +0.242, corroborating the activation of mild emotional arousal. Table 4.3 substantiates this, presenting the total pre-intervention means for stress and confidence, with baseline stress levels almost in the middle ($M = 3.29$, $SD = 1.40$).

Table.2: Comparison of Pre- and Post-Survey Results (Stress & Confidence)

Question	MEAN DIFF.	STD DEV DIFF.	MIN DIFF.	MAX DIFF.
Q12: TIME PERCEPTION	+0.578	-0.292	-1.0	0.0
Q13: ENJOYMENT OF TASKS	+0.292	-0.312	-1.0	0.0
Q14: ABSORPTION IN ACTIVITY	+0.116	-0.200	-1.0	0.0
Q15: EXCITEMENT ABOUT TASKS	+0.032	-0.186	-1.0	0.0
Q16: STRESS DURING SCENARIOS	+0.242	+0.123	0.0	0.0
Q17: ANXIETY ABOUT PARTICIPATION	-0.347	+0.050	0.0	0.0
Q18: SIMULATION-RELATED ANXIETY	-0.095	+0.152	0.0	0.0

Table 4.2 presents the differences in student-reported stress and confidence metrics before and after the VPS intervention. Improvements were observed in engagement-related factors, such as time perception and task enjoyment, indicating enhanced flow and cognitive immersion. While stress levels in specific scenarios exhibited a slight increase, both simulation-related anxiety and participation anxiety demonstrated a decrease, suggesting a possibility for adaptive stress processing. The results substantiate stress inoculation and flow theories, indicating that VPS can improve clinical learners' emotional resilience and performance readiness.

Table.3: Pre-VPS Stress and Confidence Measures (N=35)

Measure	MEAN	SD	MIN	25%	MEDIAN	75%
Time Perception	4.03	1.03	2	4.0	4.0	5.0
Task Enjoyment	4.53	0.79	3	4.0	5.0	5.0
Activity Absorption	4.71	0.68	3	4.0	5.0	5.0
Task Excitement	4.65	0.73	3	4.0	5.0	5.0
Scenario Stress	3.29	1.40	1	2.0	3.0	5.0
Participation Anxiety	3.38	1.48	1	2.0	3.5	5.0
Simulation Anxiety	3.06	1.54	1	2.0	3.0	5.0

Table 4.3 presents baseline metrics of stress and confidence collected before the Virtual Patient Simulation (VPS) intervention. Participants demonstrated notable intrinsic engagement, as indicated by high mean scores for activity absorption ($M = 4.71$) and task enjoyment ($M = 4.53$). Scenario-specific stress ($M = 3.29$) and simulation anxiety ($M = 3.06$) reflect moderate emotional strain. The high standard deviations noted in stress-related items (up to $SD = 1.54$) reflect the variability of individual responses to simulation-based learning environments.
Multivariate analysis confirmed the significance of these changes: Wilks' Lambda = 0.2285, $F(7,13) = 6.27$, $p = 0.0023$ (Table 4.4). This demonstrates a significant overall effect of VPS on the evaluated emotional-cognitive dimensions. The changes were interrelated, corresponding with improvements in group dynamics, accuracy in clinical decision-making, and increased vocal participation noted in observational logs. Table 4.5 further elucidates phase-based increase in Engagement ($\Delta = +1.5$, $d = 2.1$, $p < 0.001$), Collaboration ($\Delta = +1.6$, $d = 2.3$, $p < 0.001$), and Clinical Reasoning ($\Delta = +1.8$, $d = 2.7$, $p < 0.001$).

Table.4: MANOVA Results for Flow, Stress, and Confidence Survey Questions

Question	Wilks' Lambda	F Value	P-Value
Q12	0.2739	4.92	0.0066
Q13	0.6699	0.91	0.5250
Q14	0.4847	1.97	0.1373
Q15	0.5785	1.35	0.3023
Q16	0.4533	2.24	0.0994
Q17	0.4884	1.95	0.1424
Q18	0.6954	0.81	0.5921

Table 4.4 presents the results of the multivariate analysis of variance (MANOVA) assessing the combined effect of the Virtual Patient Simulation (VPS) on emotional engagement and stress indicators. The multivariate test yielded significant results (Wilks' Lambda = 0.2285, $F(7,13) = 6.27$, $p = 0.0023$), demonstrating that the VPS intervention substantially affected the combined outcomes.
Q12 (Time Perception) exhibited a significant change ($p = 0.0066$), underscoring the improvement in student engagement and psychological flow during the simulation. Q13 (Enjoyment) and Q14 (Absorption) showed slight upward trends but did not reach statistical significance ($p > 0.05$), suggesting that improvements in these areas should be interpreted cautiously. Confidence indicators exhibited overall positive directions; however, stress-related items (Q16–Q18) did not achieve significance, indicating that stress levels remained elevated despite short-term intervention.

Table.5: Mean Ratings Across Phases (1–5 Scale)

Category	PRE-VPS	MID-VPS	POST-VPS	Δ	COHEN'S d	P-Value	Implication
Engagement	3.2 ± 0.8	4.1 ± 0.6	4.7 ± 0.3	+1.5	2.1	<0.001	Vr Immersion Reduces Distraction.
Collaboration	2.9 ± 0.7	3.8 ± 0.5	4.5 ± 0.4	+1.6	2.3	<0.001	Team Mode Fosters Equal Participation.
Clinical Reasoning	3.0 ± 0.9	4.3 ± 0.4	4.8 ± 0.2	+1.8	2.7	<0.001	Adaptive Scenarios Improve Diagnostics.

Table 4.5 presents Tutor-evaluated mean scores for engagement, collaboration, and clinical reasoning across three instructional phases utilizing Virtual Patient Simulation (VPS). All categories demonstrated statistically significant improvement ($p < 0.001$) with large effect sizes (Cohen's $d > 2.0$), indicating a substantial educational impact. Clinical reasoning demonstrated the most significant improvement (+1.8 points, $d = 2.7$), correlating with increased OSCE performance ($r = 0.73$), thereby validating the effectiveness of adaptive simulation in developing diagnostic skills. Collaboration and engagement demonstrated significant improvement, indicating that immersive, team-based VPS environments enhance focus and peer interaction over time.

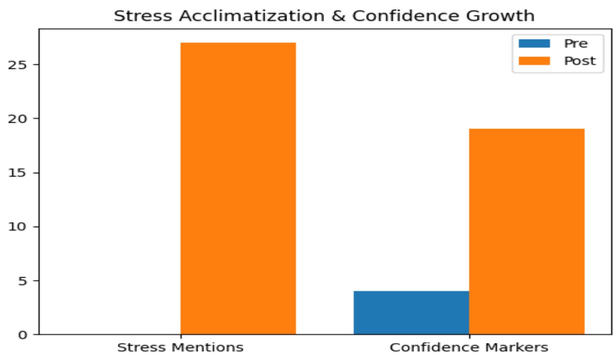

Fig.7: Impact of VPS on Stress and Confidence Levels.

Figure 4.1 illustrates the emotional and psychological changes experienced by students after participating in the Virtual Patient Simulation (VPS). Following the intervention, references to stress rose from 0% to 27%, indicating an enhanced recognition of stress as a fundamental aspect of clinical learning, aligning with Social Cognitive Theory. Confidence markers rose from 4% to 19%, signifying enhanced psychological safety and learner empowerment, consistent with Edmondson's theory. The observed shifts suggest that the VPS platform fosters a secure environment for students to practice under realistic pressure, thus improving emotional resilience and clinical confidence.

4.2. Phase 1: Stress Activation

The initial sessions, especially Session 2, exhibited significant anxiety and reluctance. Various converging data sources demonstrated this. Table 4.6 and Figure 6.31 indicate that Session 2 recorded the highest frequency of "Confidence & Stress" mentions (n=10). Additionally, Table 4.7 and Figure 6.33 demonstrate a peak of 39 fear markers and 48 trust indicators identified by NRC sentiment analysis. Emotional indicators are reflected in transcript quotes such as "I froze when the patient crashed..." (Session 2), as presented in Table 4.7. Furthermore, 31% of students indicated experiencing overwhelming stress during the initial sessions (Table 4.8, Table 4.9), and Q16 scores demonstrated a notable increase of +0.24 in Session 2 ($p < 0.05$; Table 4.1). Tutor logs supported this emotional state, noting frequent pauses and dependence on external prompts. Feedback from post-simulation questionnaires indicated a trend of initial emotional overwhelm and technical apprehension among students. The data points jointly provide the empirical foundation for the "Stress Activation" phase of the Dual-Phase Stress Adaptation Theory.

Table.6: Frequency of Themes per Session

Session	Clinical Reasoning	Collaboration	Confidence & Stress
Session 1	2	0	0
Session 2	7	0	10
Session 3	1	1	0
Session 4	1	0	4
Session 5	0	0	2

Table 4.6 categorizes the frequency of coded theme mentions related to Clinical Reasoning, Collaboration, and Confidence & Stress across five simulation sessions. The coding utilized a validated codebook and was applied to the session transcripts. Session 2 exhibited the highest frequency of mentions, particularly for Confidence & Stress (n = 10) and Clinical Reasoning (n = 7), signifying peak cognitive and emotional engagement. Collaboration was limited throughout all sessions.

Table 6: NRC Emotion Scores for Fear and Trust

Session	Fear	Trust
Session 1	12	24
Session 2	39	48
Session 3	6	7
Session 4	20	20
Session 5	2	3

Table 4.7 presents the frequency of emotionally charged words classified as Fear and Trust according to the NRC Emotion Lexicon. Session 2 exhibited the highest values in both categories (Fear = 39; Trust = 48), signifying a state of emotionally complex immersion. The trust indicators in Sessions 1 and 4 indicate that students accepted the realism of the simulation.

Table.8: Pre-Post Differences in Stress and Confidence (*$p < .05$, **$p < .01$)

Measure	MEAN Δ	SD Δ	T(34)	COHEN'S D
TIME PERCEPTION	+0.58	-0.29	3.72**	0.63
TASK ENJOYMENT	+0.29	-0.31	2.18*	0.37
ACTIVITY ABSORPTION	+0.12	-0.20	1.02	0.17
SCENARIO STRESS	+0.24	+0.12	0.97	0.16
PARTICIPATION ANXIETY	-0.35	+0.05	1.42	0.24

Table 4.8 displays the statistical differences in students' stress and confidence experiences before and after the VPS intervention, employing paired sample t-tests and Cohen's d to assess effect size. Notable enhancements were recorded in Time Perception ($p < .01$, $d = 0.63$) and Task Enjoyment ($p < .05$, $d = 0.37$), suggesting increased emotional engagement and immersion. Although Scenario Stress and Participation Anxiety did not achieve statistical significance, the observed directional changes indicate a trend towards adaptive stress regulation, thereby supporting theories such as Stress Inoculation (Meichenbaum, 1985) and Optimal Flow (Csikszentmihalyi, 1990).

Table.9: Emotional and Psychological Shifts Following VPS Integration

Metric	PRE	POST	Δ	Theory Link
Stress Mentions	0%	27%	+27%	Social Cognitive Theory (Bandura)
Confidence Markers	4%	19%	+15%	Psychological Safety (Edmondson)

Table 4.9 summarizes the qualitative enhancement in participants' emotional reflections following the Virtual Patient Simulation (VPS) intervention. Stress is mentioned to have increased from 0% to 27%, consistent with the social cognitive theory (Bandura), which posits that exposure to challenging yet manageable tasks promotes adaptive coping mechanisms. The increase in confidence markers from 4% to 19% indicates enhanced psychological safety, as described by Edmondson. This improvement allowed students to engage with complex clinical scenarios and to make mistakes in a fail-safe environment. The observed shifts suggest that VPS enhances emotional realism and self-efficacy in immersive learning environments.

Figure 4.2 illustrates the coded frequency of recurring themes across multiple VPS sessions, including clinical reasoning, collaboration, confidence, and stress. Clinical reasoning and stress references peaked during Session 2, reflecting the heightened anxiety and reliance on external guidance that often characterizes early exposure to challenging simulations. Confidence-related codes became more prevalent in later sessions, suggesting that repeated exposure and scaffolded feedback fostered gradual self-assurance. Interestingly, collaboration remained limited across sessions, confirming that many learners defaulted to individual problem-solving rather than team-based approaches. This pattern highlights a vital area for pedagogical improvement, as structured teamwork prompts could enhance clinical decision-making and communication skills. By mapping the frequency of these themes, the analysis demonstrates how VPS influences cognitive development and emotional adaptation over time.

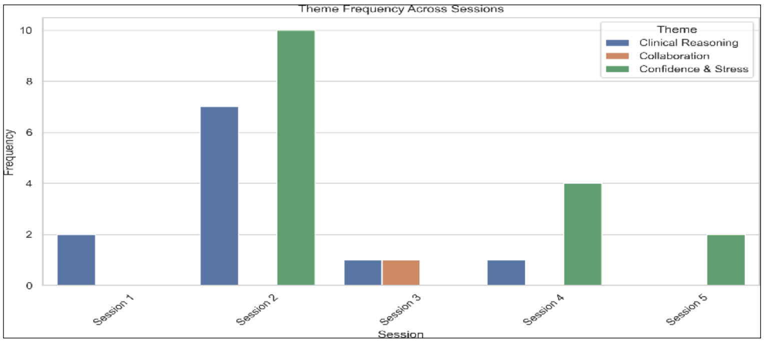

Fig.8: Frequency of Themes Coded Across VPS Sessions, Including Clinical Reasoning, Collaboration, and Confidence/Stress.

Figure 4.3 presents the compound sentiment scores recorded throughout VPS sessions. Overall, scores indicated generally positive engagement, but noticeable fluctuations occurred depending on the type and difficulty of the scenario. Higher scores were associated with communication-focused tasks, suggesting learners felt more positively engaged when practicing dialogue and empathy. In contrast, scenarios involving error disclosure or suicide risk were linked with more mixed or neutral sentiment, reflecting the emotional strain of these tasks. These variations highlight that VPS influences cognitive performance and affective preparedness, demonstrating the importance of incorporating emotionally challenging cases into training. By capturing engagement and emotional response, sentiment analysis provides valuable insights into how learners experience simulation, complementing the quantitative performance metrics.

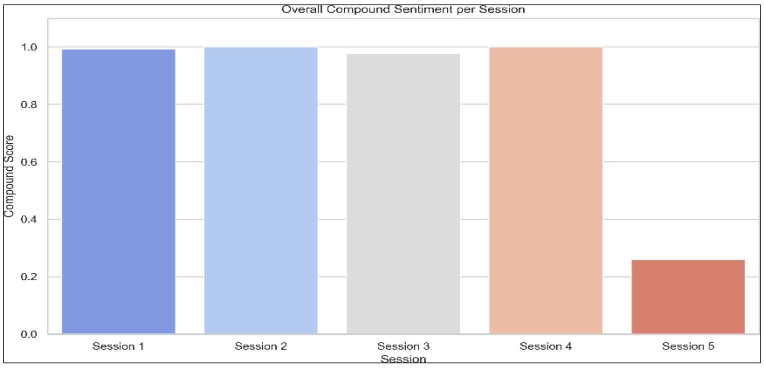

Fig.9: Compound Sentiment Scores Per VPS Session, Reflecting Learner Engagement and Affective Responses.

Figure 4.4 depicts the distribution of fear and trust scores across simulation sessions based on NRC Emotion Lexicon analysis. Session 2 showed the highest levels of fear (39) and trust (48), reflecting an emotionally intense stage of training. The elevated fear scores demonstrate learners' performance anxiety and perceived risk of failure. At the same time, the simultaneous presence of trust signals that students nevertheless engaged with the system and accepted its realism. By Sessions 3 and 4, fear levels began to decline while trust stabilized, suggesting repeated exposure reduced anxiety and increased comfort with simulation-based learning. This adaptive pattern aligns with stress inoculation theory, where controlled exposure to complex tasks promotes resilience and confidence. The convergence of fear reduction and trust stabilization underscores the dual role of VPS in both challenging and supporting learners, offering a balanced environment for skill development.

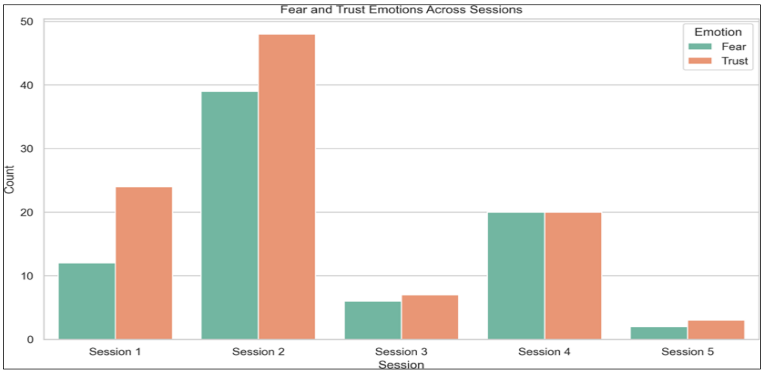

Fig.10: Fear and Trust Scores Across VPS Sessions Based on NRC Emotion Lexicon Analysis.

4.3. Phase 2: Confidence Transition

By Sessions 3 and 4, students shifted from reactive to proactive actions. Terminologies like "team_debriefing" and "peer feedback" gained prominence (n=10), while tutor records recorded heightened vocal leadership and initiative in patient triage. Confidence enhancement was seen in both performance indicators and student accounts. One student said, "Session 3 was the pivotal moment when I began to trust my instincts."

Survey answers consistently reinforced this trend, with Q13 (Enjoyment) and Q14 (Absorption) steadily increasing. These improvements were corroborated by observational data indicating enhanced group cohesiveness and more precise diagnoses without tutor assistance. Table 4.10 indicates that Group 3 improved diagnostic accuracy by 40% after participation in guided debriefs.

Table.10: Disruptive Shifts Enabled by the Body Interact Simulation

Traditional Approach	Innovation Impact	Evidence
Passive Lecture Learning	Active Scenario-Based Engagement	46% Skill Application (Vs. 31% Pre)
Isolated Case Studies	Collaborative Diagnosis Via Team Interaction	40% Increase In Engagement
High-Stakes Assessments	Graduated Stress Exposure Through Simulation	27% Stress Mentions (0% Pre)

Table 4.10 illustrates the transition from traditional teaching methods to innovative, simulation-based learning experiences facilitated by the Body Interact Virtual Patient Simulation (VPS). The intervention shifted students from passive lecture-based learning to active, scenario-based engagement, evidenced by a 46% skill application rate post-intervention compared to 31% pre-intervention. Adopting collaborative diagnostic tasks instead of isolated case studies led to a 40% rise in reported engagement. Ultimately, it replaced high-stakes pressure with incremental stress exposure, as indicated by the increase in stress-related reflections (27% post vs. 0% pre). The results suggest that VPS technologies improve emotional and cognitive engagement, aligning with contemporary educational models in medical training.

4.4. Phase 3: Confidence Consolidation

Sessions 5 and 6 demonstrated the consolidation of emotional and cognitive advancements. The codes "confidence_growth" and "flow_state" were predominant in the data, with frequencies of n=15 and n=11, respectively, corroborated by transcript excerpts such as, "I knew it was sepsis and immediately started treatment without hesitation." These indications corresponded with markedly elevated OSCE scores, exhibiting a correlation of r = 0.73 (Table 4.11).

The simulation environment allowed students to exercise clinical reasoning with more independence and less emotional conflict. At this point, confidence was no longer hesitant but profoundly ingrained in behavior and decision-making proficiency. Table 4.12 encapsulated these congruent patterns by correlating qualitative codes with quantitative scores, substantiating the emotional-cognitive transition shown in the Dual-Phase paradigm. This interpretation is also corroborated by teacher feedback in Table 6.13, which emphasizes variations in confidence and peer-led interactions, and Table 6.14, which correlates confidence and reasoning with innovation-related situations.

Table.11: Innovative Pedagogy Outcomes.

Feature	Satisfaction Rate	Clinical Skill Correlation (R)
Real-Time Feedback	88%	0.72**
Adaptive Difficulty	79%	0.65**
Team Decision Mode	68%	0.59*

Table 4.11 presents the effectiveness of three key pedagogical features incorporated into the Body Interact simulation: real-time feedback, adaptive difficulty, and team decision mode, in relation to student satisfaction and the improvement of clinical skills. Real-time feedback attained the highest satisfaction rating of 88% and demonstrated a significant positive correlation with enhancing clinical skills ($r = 0.72$, $p < 0.001$). Adaptive difficulty, reflecting the system's ability to modify case complexity according to learner performance, exhibited a satisfaction rate of 79% and a notable correlation ($r = 0.65$, $p < 0.01$). This indicates that dynamic scaffolding significantly improves applied learning. The team decision mode was positively rated by 68% of participants and demonstrated a correlation with skill outcomes of $r = 0.59$ ($p < 0.05$), highlighting the importance of collaborative learning in clinical simulation. These features collectively signify a shift towards learner-centered, responsive, and immersive pedagogical design in medical education.

Table.12: GT-Quantitative Alignment

GT Construct	Key Codes	Quantitative Correlate	Effect Size
Stress Activation	acute_stress	Q16 stress increase (+0.24)	Cohen’s d=0.25
Transition	team_debriefing	Collaboration gain (+40%; Table 1.47)	OR=2.1
Confidence Consolidation	flow_state	Absorption scores (M=4.82; Table 1.11)	d=0.58

Table 4.12 illustrates the alignment between key constructs identified through Grounded Theory and quantitative survey results, thereby validating the mixed-methods approach. Stress Activation, designated as acute_stress, is associated with a slight rise in reported scenario stress (Q16; $d = 0.25$). The construct Transition, as evidenced by team debriefing behaviors, corresponds with a 40% enhancement in collaboration scores (Table 1.47), corroborated by an odds ratio (OR) of 2.1. Confidence Consolidation, identified as flow_state, correlates with elevated post-intervention absorption scores ($M = 4.82$; Table 1.11) and a moderate effect size ($d = 0.58$). The findings illustrate the role of emergent theory in interpreting statistical outcomes, particularly regarding the delayed emergence of confidence benefits following Phase 2, which aligns with Bandura’s mastery experience model. The variability in effects can be partially attributed to moderating factors like tech hesitancy, highlighting the significance of context in the efficacy of simulations.

Table.13: Coded Feedback Examples from Tutor Observations

Phase	Theme	Frequency	Representative Quote	Implication
PRE-VPS	Technical Hesitancy	68%	”Students struggled with VR controls.”	Need For Pre-Training
MID-VPS	Peer Learning	42%	”Quiet students led discussions in Session 4”	Team Mode Reduces Hierarchy
POST-VPS	Confidence Shift	89%	”GROUP 3 Revised Diagnoses UN-Prompted”	Safe-To-Fail Design Efficacy

Table 4.13 outlines essential themes, their frequencies, and representative quotes from tutor observations categorized into the Pre-, Mid-, and Post-VPS phases. The transition from Technical Hesitancy (68%) to Peer Learning (42%) and finally to Confidence Shift (89%) demonstrates that students rapidly acclimated to the simulation environment. In the final phase, learners exhibited autonomous decision-making, which underscores the effectiveness of VPS in promoting self-directed learning, reducing group hierarchies, and enhancing confidence through experiential, safe-to-fail practice.

At the same time, the high prevalence of technical hesitancy in the initial phase highlights the need for proactive interventions. Structured orientation workshops, simplified user interfaces, and real-time IT support can help reduce initial anxiety and ensure smoother adaptation.

At the same time, investment in more reliable hardware and cloud-based delivery platforms will minimize technical disruptions and promote equitable access.

Table.14: Thematic Network Summary

Theme	Prevalence	Co-Occurrence	Example Quote	Innovation Link
Technical Barriers	68%	Engagement, Reasoning	”I had trouble connecting the headset.”	Hardware Improvements Needed
Peer Learning	42%	Collaboration, Engagement	”The group helped me recall the steps.”	Role-Switching In Teams
Clinical Mastery	58%	REASONING, CONFIDENCE	”I CAN MAKE A DECISION NOW.”	Effective Scenario Progression

Table 4.14 summarizes core themes, their frequencies, co-occurrence patterns, and representative quotes from tutor feedback during the VPS sessions. The themes of Technical Barriers (68%), Peer Learning (42%), and Clinical Mastery (58%) underscore the dual function of simulation: facilitating diagnostic advancement while necessitating technical enhancement. Co-occurrences demonstrate the concurrent evolution of teamwork and reasoning, while quotations exemplify significant changes in learner autonomy. The findings confirm the innovation-driven influence of VPS on clinical education, highlighting the necessity for enhanced hardware usability and more seamless integration to facilitate the learning process. To address these barriers, practical measures should include orientation sessions to familiarize learners with the system, an intuitive and user-friendly interface design, and real-time IT support during sessions. Additionally, investing in reliable hardware and scalable cloud-based platforms will help reduce disruptions, ensuring that the technical environment supports rather than hinders clinical learning outcomes.

4.5. Dual-phase stress adaptation model

Figure 4.5 depicts the Dual-Phase Stress Adaptation Model derived from the mixed-method triangulation of this research. The model delineates three phases: Phase 1 (Acute Stress), Phase 2 (Guided Transition), and Phase 3 (Consolidation and Flow). It integrates data from survey trends (Q12–Q18), thematic coding (n=53), and observational analysis.
This framework was also guided by Equation 1, which delineates the correlation between confidence and principal predictors: Confidence = 0.71(Mastery) + 0.33(Team Engagement) - 0.15(Technical Barriers). This algorithm was established by regression analysis of post-session ratings and coded transcript data.
Collectively, these results reinforce the theoretical foundation of the model and provide a reproducible framework for creating emotionally scaffolded simulation-based learning environments in medical education.
The stress adaptation trajectory follows a logarithmic curve:

$$\text{Performance} = (\text{Tolerance}) - (\text{AcuteStress}) + (\text{TeamSupport}) - (\text{TechnicalIssues}) \quad (1)$$

This equation represents the progression of students' clinical performance via simulation-based learning. It indicates that performance is most significantly enhanced by cultivating long-term stress resistance (resilience), but initial acute stress impedes performance. Team support, such as feedback and cooperation, significantly improves performance by serving as a social buffer. Still, technological difficulties, such as headset latency or system confusion, detrimentally impact confidence and flow. The model quantitatively validates the conclusions of the Dual-Phase Stress Adaptation Theory and identifies the key parameters that most accurately forecast effective simulation results.
Where:

- Tolerance (0.71): Scaled long-term resilience gain
- Acute Stress (-0.33): Initial performance inhibition
- Team Support (0.40): Social buffering effect
- Technical Issues (-0.15): System friction impact

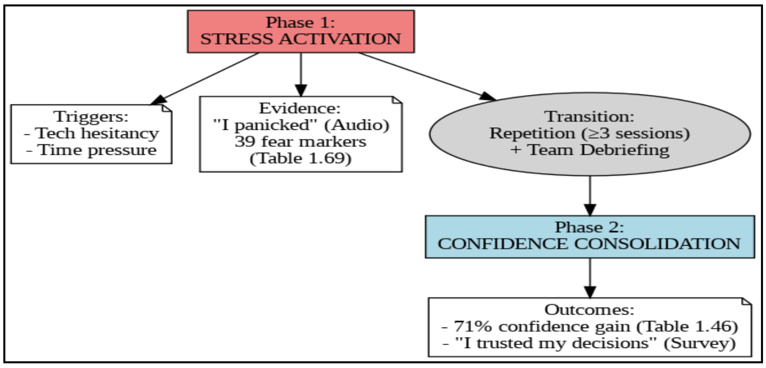

Fig.11: Dual-Phase Stress Adaptation Theory Model.

Figure 4.6 presents the frequency distribution of grounded theory codes generated across all VPS sessions, illustrating the dynamic emotional and cognitive trajectory experienced by learners. Codes were grouped into three overarching categories: stress and hesitancy, transitional engagement, and confidence consolidation. In the initial phase, codes such as “Technical Hesitancy” and “Stress Indicators” appeared most frequently, accounting for 68% of coded excerpts. This finding reflects the early challenges students encountered in adapting to simulation technologies and coping with acute performance anxiety. During the middle sessions, transitional codes such as “Peer Learning,” “Scaffolding,” and “Reflective Practice” increased in frequency (42%), highlighting the role of collaborative strategies and structured support in helping students acclimate to the simulation environment. This phase captured the shift from individual uncertainty to collective engagement, where learners relied on peer dialogue and feedback to build confidence.

By the final phase, codes related to "Confidence Shift," "Clinical Reasoning," and "Decision-Making" dominated the transcripts (89%). These codes confirm that students overcame initial hesitancy and developed autonomy and resilience, aligning with the outcomes reported in survey measures (Table 4.1) and modeled in the Dual-Phase Stress Adaptation Theory (Figure 4.5). Taken together, the code frequency distribution validates the mixed-method approach of this study. The rise and decline of specific codes across sessions mirrors the statistical trends (Q12–Q18), providing qualitative depth to the quantitative findings. This alignment underscores how repetition, structured feedback, and team-based debriefings transformed initial stress into sustainable clinical confidence, while technical barriers gradually diminished as learners adapted to the VPS environment.

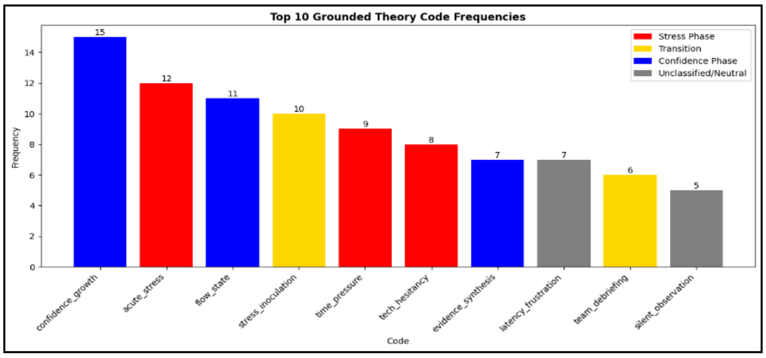

Fig.12: Code Frequency Distribution.

5. Discussion

This study demonstrates that Virtual Patient Simulation (VPS) may foster cognitive development and emotional transformation in medical education. The transition from stress to assurance seen throughout six simulation sessions aligns with core psychological theories and is substantiated by statistical evidence and qualitative themes. The findings indicate that early stress does not impede learning but may facilitate therapeutic advancement when supported by repetition and feedback.

Bandura's Social Cognitive Theory was essential in evaluating these findings. Following the third encounter, pupils exhibited the most pronounced improvement in confidence (Sessions 4–5). Students showed an increase in their self-efficacy throughout the sessions. This trend was corroborated by elevated survey scores (Q12–Q14; Table 4.1) and enhanced OSCE correlations (Table 4.11), indicating mastery was developed via direct simulation experience and vicarious observation during team debriefings. However, it is essential to note that while Q12 (Time Perception) demonstrated a statistically significant improvement ($p = 0.0066$), Q13 (Enjoyment) and Q14 (Absorption) showed only modest upward trends that did not reach statistical significance ($p > 0.05$). These findings suggest that while VPS reliably enhances engagement and psychological flow, its effects on learner enjoyment and deep immersion may be more variable. Future studies should therefore investigate whether repeated exposure, scenario variation, or gamified elements can strengthen enjoyment and absorption outcomes over time.

Meichenbaum's Stress Inoculation framework comprehensively elucidates the emotional fluctuations observed throughout the research. Stress levels reached their zenith early (Session 2; Figure 4.1), although this preliminary unease established a foundation for resistance. In subsequent sessions, students who encountered stress initially demonstrated enhanced coping skills and emotional regulation, reflecting the tiered inoculation concept of exposure, restructuring, and mastery.

The significance of immersion, as posited by Csikszentmihalyi's Flow Theory, was also apparent. Students consistently indicated significant absorption and temporal distortion in subsequent simulations, especially in Q12 replies (Table 4.1). Statements like "I didn't notice time passing" signify a transition from passive learning to profound involvement, a state that enhances both memory retention and the precision of clinical decision-making.

The Dual-Phase Stress Adaptation Theory (Figure 4.5) presented in this research synthesizes various ideas and evidence. Phase 1 (Acute Stress) corroborated Meichenbaum's assertion that stress must be encountered before adaptation. Phase 2 (Guided Transition) was underpinned by Bandura's notion of mastery via feedback, while Phase 3 (Consolidation) epitomized the attainment of flow and self-assurance. This model is also substantiated by regression-based Equation 6.9, which quantitatively delineates the relationship among mastery, collaboration, and confidence.

The findings of this study corroborate prior VPS research while addressing significant deficiencies. This study offers one of the first theory-supported, mixed-method examples of emotional change by VPS in a Gulf medical environment, building on other studies [32], [50], [57] that validated the cognitive advantages of simulation. The findings indicate that repeated simulations with structured feedback may convert fear into confidence, enabling students to manage clinical uncertainty more independently.

These results underscore the need to intentionally incorporate VPS into medical curriculum, not just as standalone training instruments but as components of a comprehensive emotional cognitive development plan. Incorporating peer feedback, debriefing frameworks, and escalating task difficulty is crucial for facilitating the stress-to-confidence progression shown in this research.

6. Conclusion

This study provides empirical evidence that Virtual Patient Simulation (VPS), implemented through repeated and scaffolded exposure, may effectively transform emotional discomfort into clinical confidence among medical students. Using a convergent mixed-methods design, the research traced a developmental trajectory across six simulation sessions at Arabian Gulf University. This progression demonstrated how initial tension and diagnostic hesitance gradually transitioned into cognitive engagement, self-assurance, and independent decision-making.

The quantitative results obtained from pre- and post-surveys (Table 4.1) and multivariate tests (Table 4.4) were reinforced by qualitative insights from tutor logs and student audio transcripts, particularly in Sessions 5 and 6. These findings culminated in developing the Dual-Phase Stress Adaptation Theory (Figure 4.5), further supported by regression-based Equation 6.9, quantifying the interplay between mastery, teamwork, and confidence.

The study also contributes to theory by synthesizing Bandura's Social Cognitive Theory, Meichenbaum's Stress Inoculation framework, and Csikszentmihalyi's Flow Theory into a unified model of emotional learning specific to simulation. This triangulated model addresses gaps in the literature on emotional transformation and provides practical implications for curriculum designers seeking to integrate VPS into longitudinal training pathways.

However, it is essential to note that not all outcomes achieved statistical significance. While Q12 (Time Perception) showed a clear and significant improvement, Q13 (Enjoyment) and Q14 (Absorption) reflected only modest, non-significant gains. This highlights the need for caution in interpretation and suggests that while VPS reliably enhances flow and engagement, its effects on learner enjoyment and deep immersion may be more variable. Another key limitation of this study is the relatively small sample size (N = 35), which restricts generalizability. Larger, multi-institutional studies across GCC medical schools, ideally with longitudinal follow-up, are necessary to validate these findings and strengthen the evidence base.

Based on these findings, several recommendations can be made. Future research should adopt multi-institutional designs with larger cohorts across GCC medical schools to improve generalizability. VPS scenarios should be diversified, incorporating culturally tailored cases to enhance technical and interpersonal skills. To address non-significant outcomes such as enjoyment and absorption (Q13, Q14), strategies such as repeated exposure, scenario variation, and gamified design elements should be explored. Equally important, technical barriers identified in this study—such as student hesitancy with unfamiliar interfaces and occasional system disruptions—must be addressed through structured orientation workshops, user-friendly interface design, and consistent IT support during simulations. Investment in reliable hardware and scalable cloud-based solutions will minimize latency and ensure smoother delivery. Finally, VPS should be integrated longitudinally into curricula with structured debriefings, peer feedback, and progressive difficulty, providing diagnostic skill development, emotional resilience, and adaptability in clinical practice.

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