

EFFECT OF LEARNING SCIENCE THROUGH GAME BASED LEARNING (GBL) ON REFLECTIVE DEPTH SCORE OF UNDERGRADUATE NURSING STUDENTS

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Abstract

BACKGROUND

Sport games play a significant role in maintaining the psychological wellbeing of learners (Liu et al, 2024). The 21st century skills as defined by the researchers is collaborative and cooperative interactive skills, communication and problem solving skills (Chung et al, 2017). The current study aims to implement Game Based Learning (GBL) entitled "Kinetic Minds" where students will be learning scientific concepts through sport games with a goal to work for the mental wellbeing of the nursing students who are considered to be the front line workers in the healthcare. Research Objective:

To assess the effect of learning science through Game Based Learning (GBL) on Reflective Depth Score of Undergraduate Nursing Students

Methodology: Following the approval from ERC and head of the department, the students providing informed consent will be included in the study. Students of BSN II were taught the chains of infection through a traditional lecture based method followed by a Game Based method using Ludo board game that involved physical activity in an open college area. Same students from both groups (traditional versus GBL) were then asked to fill the Gibb's reflective model to express their reflections on the teaching pedagogy.

Results: Results will be analyzed through Stata. Mean and standard deviation will be calculated for all numeric variables and means for reflective depth scores in control and experimental groups will be calculated through *The paired t-test results indicate a statistically significant increase in Total Gibbs Scores from pre-test to post-test.* For a sample size of *90 observations*, the mean score rose from *21.54* to *26.20*, yielding a mean difference of *-4.66*. The associated paired t-test produced a t-statistic of *-8.2442* with *89 degrees of freedom*, resulting in a two-tailed p-value of *< 0.0001*. The frequency of containing the true mean of *-4.6* in an interval from *-3.5* to *-5.7* was *95 %*. This confirms that the intervention or condition between the two testing periods led to a measurable, genuine improvement in scores rather than a change by random

chance.

Introduction

Background:

Sport games contributes essentially in improving psychological wellbeing of learners (Liu et al, 2024). Globally, teachers are now utilizing the mode of competitions amongst their students as a key source to spark their thirst for learning (Ribeiro et al, 2018). The Number Navigation Game deployed by (Brezovszky et al, 2019) was a breakthrough to facilitate students in acquiring adaptive number knowledge. Beside this, the initiation of Final Frontier Game ameliorated the knowledge of 53 students regarding Mercury and Venus (Mawas et al, 2020). Therefore, teaching and/or assessing students via creative tools such as Game Based Learning (GBL) could be an asset in today's era to make the classroom environment healthier and innovative.

Statement of the Problem:

Being an educator since 10 years, it has been closely observed by the primary investigator that most of the time teachers are using the traditional strategy of delivering the lectures wither through PowerPoints or the conventional white board method. This has limited student's eagerness to think out of the box and they try to absorb the same technique of teaching as part of their learning. At the end, students are expected to produce good grades academically. However, the satisfaction level of students is now declining as they are living in this era of digitalization and therefore expects some innovative ideas from their educators. The problem lies in the fact that despite of promising results from using Game Based Learning as a key teaching tool, very limited utilization has been observed.

Hypothesis:

There is an effect of learning Science through Game Based Learning (GBL) on Reflective Depth Score of Undergraduate Nursing Students

Purpose of the study:

In the current study, it is intended to introduce the Game Based Learning (GBL) in the form of

sport games. A game will be utilized where students will be enacting and playing while learning and being assessed at the same time. The aim is to examine the impact of such learning tools on the satisfaction of undergraduate nursing students.

Significance of the study:

The study will open new insights of utilizing the sport games for the learning and assessment of the students. If high level of satisfaction is obtained from students, this study will be used by the primary investigator as a prototype to develop a training module for teachers of all levels. This module will also be reported to ORIC for filling patents and IP disclosure. The training will prepare the educators to utilize the Game Based Learning tools for creating a classroom where a student will come to learn any difficult concept with fun, energy, motivation and innovation.

Review of Related Literature

Game Based Learning in the educational process is the application of games or something that presents the content, image and reality of a concept. In the educational process, Game Based Learning is defined as the utilization of video games or materials that can express the content, image or reality of a concept (Ge et al, 2018). In UK, the prevalence of usage of video games has been reported to be 89 % by children and adolescents (Ferreira et al, 2016). In a learning environment which is student centered, the world of education is in its evolution phase aiming to adopt such methods that can be fruitful for student's knowledge. This environment is mainly focused on "understanding user/learner needs as part of determining the system's effectiveness" (Tsay et al, 2018). In order to elevate student's motivation and to decline their reprehension in classrooms, it is highly essential for educators to begin switching their traditional teaching methods into innovative learning methods

(Kereki et al, 2017). In accordance with the literature of recent years, the pedagogy of Game Based Learning has been utilized by different researchers with their own focus and goal (Chang et al, 2019); (Fotaris, 2017); (Gao et al, 2020). Game Based Learning has found to be effective in inculcating problem solving skills amongst students (Moon et al, 2024). Recent studies in this area has increased the acceptance of Game Based Learning amongst educators (Yeo et al, 2022). Based on the above literature, the current study aims to assess the effect of Game Based Learning on the level of satisfaction of students in the course of Tropical and Communicable Diseases to BSN Year III students. A very limited literature was found on Game Based Learning in university students and even that literature was also based on digital games. In this modern era, where the world is coming under the influence of digitalization and artificial intelligence, use of physical sport games to satisfy students is very limited. Researchers still are focusing on using sport games to implement the essential motor reflexes that ultimately improves the blood circulation and works on boosting immunity. The 21st century skills as defined by the researchers in this era is not just confined to reading, writing or solving arithmetic calculations (Qian et al, 2016). Rather collaborative and cooperative interactive skills, communication and problem solving skills have now been considered the major goals of this modern century (Chung et al, 2017) and to achieve this goal, Game Based Learning plays a pivotal role (Hamari et al, 2015); (Sung et al, 2017). Since Game Based Learning does not necessarily focus on electronic gadgets rather the use of any work or training in comprehending a concept through game also comes under the same domain (Al Azawi et al, 2016). Studies in the last few years have shown promising results on raising the motivation, satisfaction and interest of students by using this technique (Hussein et al, 2019); (Hwa et al, 2018); (Khan et al, 2017). The current study aims to utilize sport games as a key element of Game Based Learning and to see its effect on the satisfaction level of

undergraduate nursing students. The reason behind usage of this technique is that few studies reveals that despite of digitalization, using of video games for learning still can produce some negative effects on the emotional state, behavior, cognitive abilities and motivation of students (Qian et al, 2016); (Giannakas et al, 2018)

Methodology

Study Setting & Study Design:

This research was conducted at Ziauddin University Faculty of Nursing & Midwifery (ZUFONAM) on students taking Generic BSN Year I Microbiology course at ZUFONAM. The study design is experimental research that used quasi-experimental research design (pre and posttest). The sample size via WHO software was found to be 90.

Method:

Phase I:

Following the approval from ERC and head of the department, the principal investigator along with two co-facilitators booked up a slot with the batch where students were informed regarding the complete study protocol. Students who gave their informed consent to be involved in the study signed written informed consent forms.

In this study one facilitator (PI) and 2 co facilitators were involved. These co-facilitators were trained on the complete protocol of this study. Following this, 90 students who gave informed consent were given a 10-minute lecture session by the primary investigator of this research where the study briefings was provided to students in the presence of co-facilitators

Phase II:

1. After receiving formal consent from the students, the topic of chain of infection was taught through a traditional lecture-based method by the primary investigator and the co-facilitators recruited by the primary investigator. The period of teaching was 30 minutes. Students were asked to construct different chains of infections as assigned by the facilitators and share their quick responses.

2. The session was followed by the filling of Gibb's Reflective model for the session delivered via traditional method.

Phase III:

3. This session was then followed by another session after around 2-3 days that covered the chain of infection for infection for 30 minutes and then execute game-based learning as below:

- a. Students were divided into 05 teams with 15 students in each team
- b. The primary investigator called group 1 and 2 to perform the practice of developing chain of infection.
- c. The students were asked to report at station 1 where a bowl on table was placed, inside the bowl 06 sealed envelopes were present labeled from 1 till 6. One of the team leads as per their mutual consensus rolled a dice on a Ludo Board game and picked one sealed envelope as per the tossed number (from 1-6)

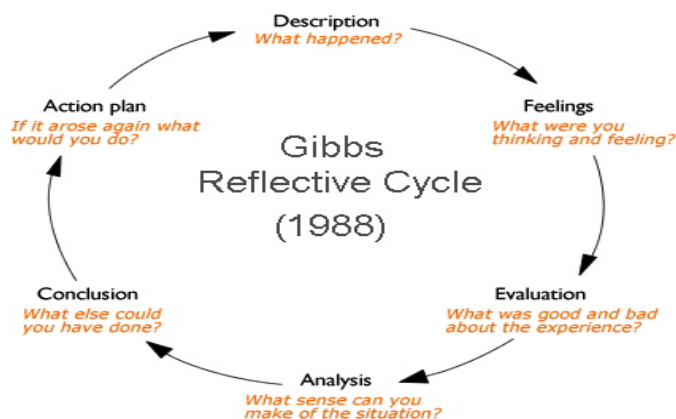
d. The students were then asked to go to station 2 in an open area where two teams sat and the game of “Kinetic Minds” began. For each single stage of the infection, one of the team members as nominated by the team lead came to pick the correct flashcard for the respective stage of chain of infection.

e. The team who completed the chain of infection with more stages won the round and will receive a small token of appreciation.

f. The game proceeded for all remaining teams as per the above protocol.

Phase IV:

After intervention phase, students were requested to complete the Gibb’s reflective model through a google document and data will be collected and stored with password protected files for safe and secure maintenance.



1. Description

- I was able to clearly describe the learning activity.
- I identified the key events of the game-based learning session.

2. Feelings

- I could express my emotions during the learning activity.
- I was aware of how my feelings influenced my learning.

3. Evaluation

- I was able to identify what went well in the learning activity.

- I was able to recognize the challenges I faced.

4. Analysis

- I understood why certain aspects of the activity were successful.
- I was able to link my experience to theoretical concepts.

5. Conclusion

- I drew meaningful lessons from this experience.

- I could identify what I would do differently in the future.

6. Action Plan

- I developed clear strategies to improve my future learning
- I feel prepared to apply this experience to new situations.

Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

Results:

Table 1: Demographic Characteristics of Study Participants (N = 90)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	47	52.22
	Female	43	47.78
Total	—	90	100.00

Demographic Characteristics:

A total of 90 Year One nursing students participated in this study. The sample was made up of 47 males (52.22%) and 43 females (47.78%) giving a balanced gender breakdown as shown in Figure 1. This even gender distribution minimizes gender confounding of outcome scores and enhances internal validity of the study. All subjects and students were in the same academic year; the same teaching conditions were applied for the pre- and post-test and the same scoring tool of Gibbs was used

Figure 1: Gender Distribution of Participants (N=90)

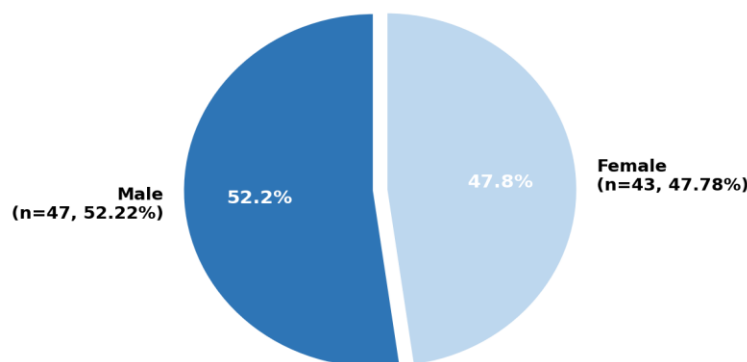


Figure 1: Gender Distribution of Study Participants (N=90)

Descriptive Statistics: Pretest Scores (Traditional-Lecture Based Teaching)

Table 2 shows the descriptive statistics for each domain from the pretest, which was administered after the conventional lecture-based instruction. Cohort mean total score on the pre-test was 21.54 (SD = 4.90, range 6–30) which was at the lower end of the 'Good reflection' category (19–24) on the rubric for Gibbs'. The mean (M = 3.87, SD = 0.99) for students' pre-test

scores was the greatest for the Conclusion domain, indicating that at the individual domain level, students were able to extract some learning points from the experience even when they were taught passively. The pre-test mean score for the Feelings domain was low (M = 3.10, SD = 1.19) and the pre-test SD was high, indicating the low potential for eliciting meaningful emotional self-reflection with didactic lecture-based delivery. At the level of individual items, all the domains

were in the 'Good' range, but were quite variable, as would be expected in a surface-level,

reflective processing style that is characteristic of the passive instructional environments.

Table 2: Descriptive Statistics of Pretest Scores for Traditional-Lecture based Teaching

Gibbs' Domain	Reflective Cycle	n	Mean	Std. Dev.	Min	Max
Description		90	3.77	0.98	1	5
Feelings		90	3.10	1.19	1	5
Evaluation		90	3.60	1.04	1	5
Analysis		90	3.57	1.11	1	5
Conclusion		90	3.87	0.99	1	5
Action Plan		90	3.64	1.23	1	5
Total Gibbs Score (Pre-test)		90	21.54	4.90	6	30

Descriptive Statistics: Posttest Scores (GBL Based Teaching)

Descriptive statistics for each domain are given in Table 3 for the post-test administered after the outdoor game-based learning activity. Improvements were seen in all six of Gibbs' domains. The mean total post test score was 26.20 (SD = 3.84, range 9–30) which represented an increase of an entire reflective category from the pretest to the category of 'Excellent, deep reflection' (25–30). The experiential, goal-oriented nature of game-based learning proved to be the most effective support for cultivating forward-looking, practice-oriented reflection, as evidenced by the highest mean (M = 4.44, SD =

0.82) in the Action Plan domain. The Description (M = 4.40, SD = 0.85) and Conclusion (M = 4.40, SD = 0.79) domains followed closely. Most notably, the Feelings domain showed the greatest absolute growth (3.10–4.33), indicating that the game's participatory approach with emotional appeal, social interaction and competition significantly improved students' ability to be emotionally attuned and reflect on their emotions. In all domains, the amount of variation or heterogeneity reduced from pre- to post-test as evidenced by decreased standard deviations after the GBL intervention.

Table 3: Descriptive Statistics of Posttest Scores for GBL based Teaching

Gibbs' Domain	Reflective Cycle	n	Mean	Std. Dev.	Min	Max
Description		90	4.40	0.85	1	5
Feelings		90	4.33	0.76	1	5
Evaluation		90	4.39	0.77	2	5
Analysis		90	4.23	0.95	1	5
Conclusion		90	4.40	0.79	1	5
Action Plan		90	4.44	0.82	1	5

Gibbs' Reflective Cycle Domain	n	Mean	Std. Dev.	Min	Max
Total Gibbs Score (Post-test)	90	26.20	3.84	9	30

2.4 Pre-test vs. Post-test Domain Score Comparison

Table 4 and Figure 2 show the pre- and post-test mean domain scores and the average scores for each domain after the GBL intervention. Positive improvements across all six Gibbs' domains were observed ranging from +0.53 (Conclusion) to +1.23 (Feelings). The Feelings domain exhibited the greatest change, which is of theoretical importance. There were also

significant improvements in the domain of Action Plan (+0.80), Description (+0.63), Evaluation (+0.79), Analysis (+0.66), and Conclusion (+0.53). The overall mean score improvement (+4.66) is statistically significant, and also clinically and educationally significant, with the scores moving from the lower end of 'Good reflection' to the 'Excellent deep reflection' band.

Table 4: Comparison of Gibbs' Reflective Cycle Domain Mean Scores – Pre-test vs. Post-test with Mean Gain

Gibbs' Domain	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Gain (Post – Pre)
Description	3.77 (0.98)	4.40 (0.85)	+0.63
Feelings	3.10 (1.19)	4.33 (0.76)	+1.23
Evaluation	3.60 (1.04)	4.39 (0.77)	+0.79
Analysis	3.57 (1.11)	4.23 (0.95)	+0.66
Conclusion	3.87 (0.99)	4.40 (0.79)	+0.53
Action Plan	3.64 (1.23)	4.44 (0.82)	+0.80
Total Score	21.54 (4.90)	26.20 (3.84)	+4.66

Figure 2: Pre-test vs. Post-test Mean Scores Across Gibbs' Reflective Cycle Domains

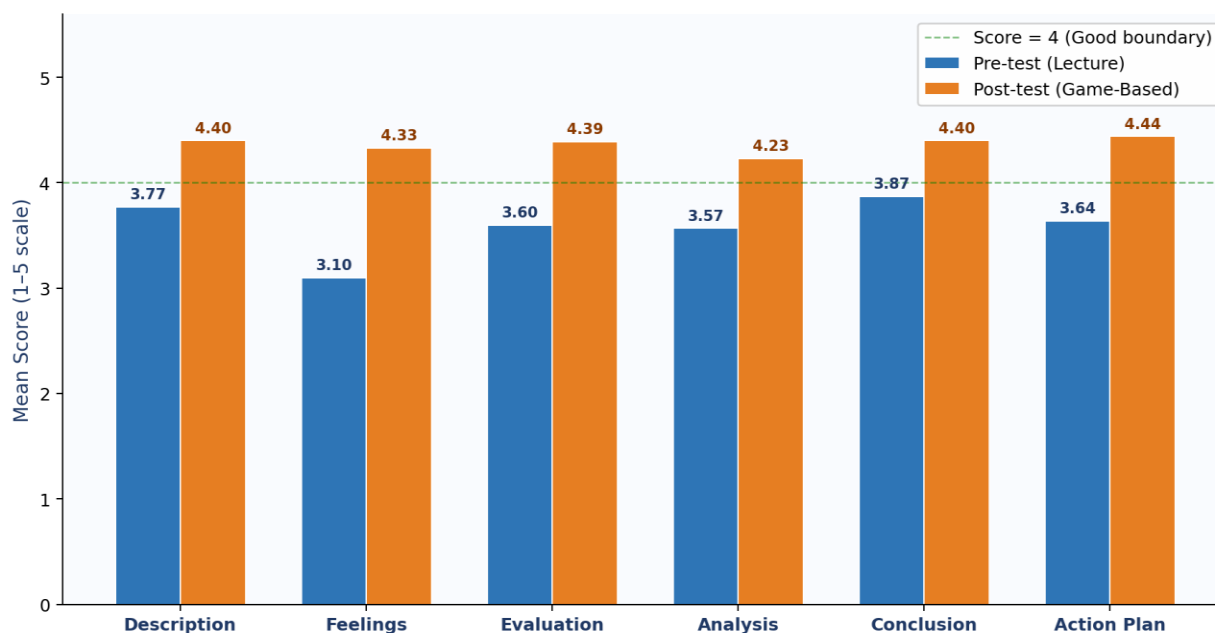


Figure 2: Pre-test vs. Post-test Mean Scores Across Gibbs' Reflective Cycle Domains

Figure 3: Mean Score Gain per Gibbs' Domain (Post-test minus Pre-test)

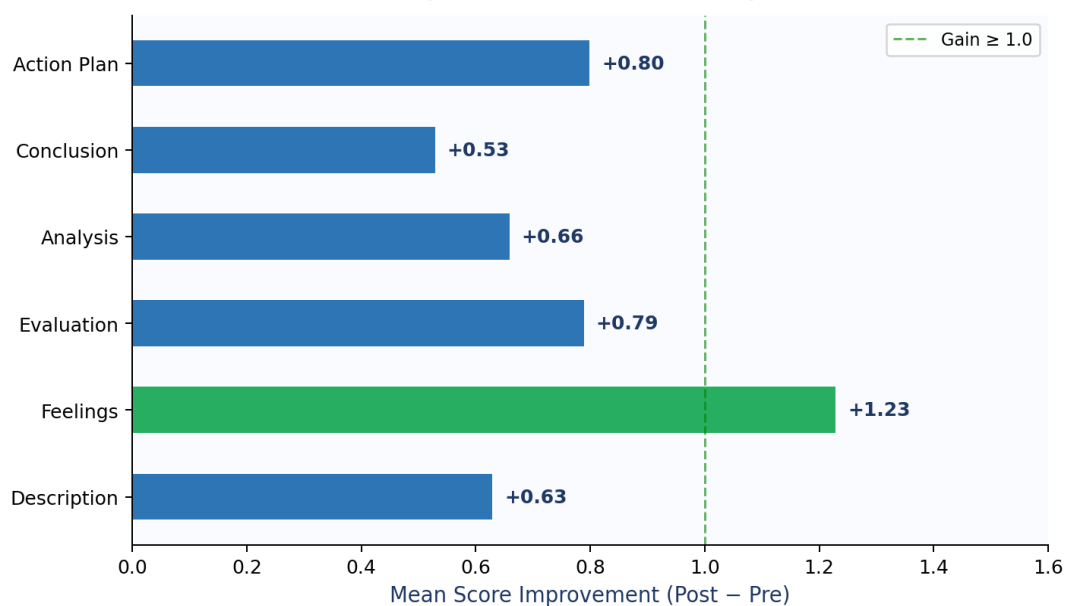


Figure 3: Mean Score Gain per Gibbs' Domain (Post-test minus Pre-test)

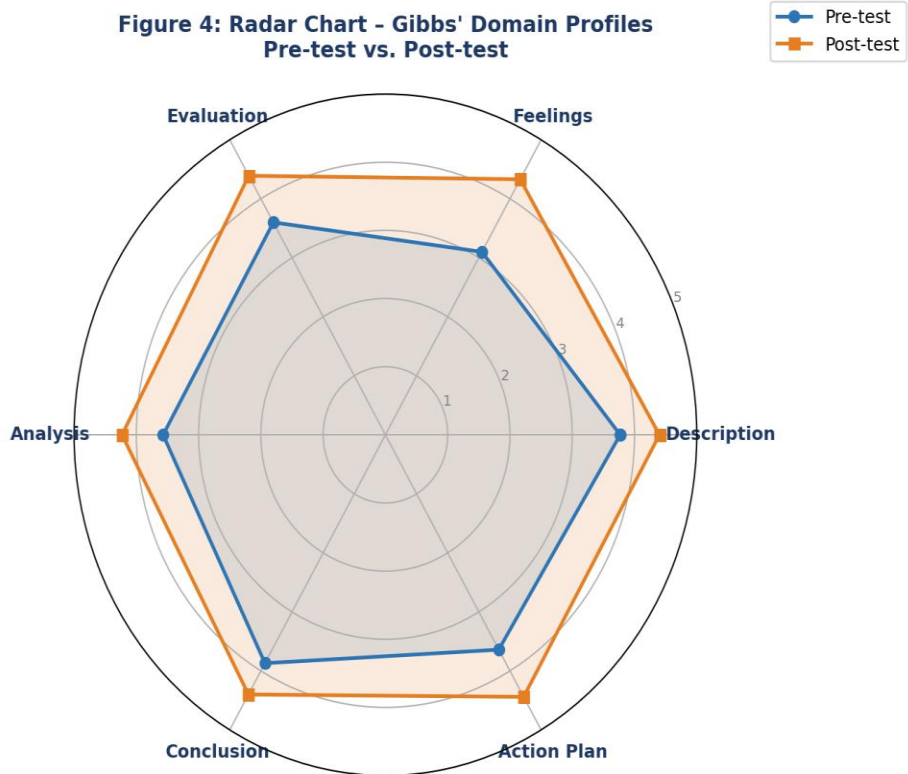


Figure 4: Radar Chart – Gibbs' Reflective Cycle Domain Profiles: Pre-test vs. Post-test

Figure 3 further illustrates the magnitude of gain per domain, confirming that the Feelings domain benefited most from the GBL intervention while all other domains also surpassed the +0.5 improvement threshold. Figure 4, the radar chart, provides a holistic

visual representation of the shift in students' reflective profile across all six Gibbs' domains simultaneously, demonstrating the consistent outward expansion of the post-test profile relative to the pre-test profile across every domain vertex.

2.5 Distribution of Students Across Gibbs' Reflective Score Categories

Figure 6: Distribution of Students Across Gibbs' Reflective Categories

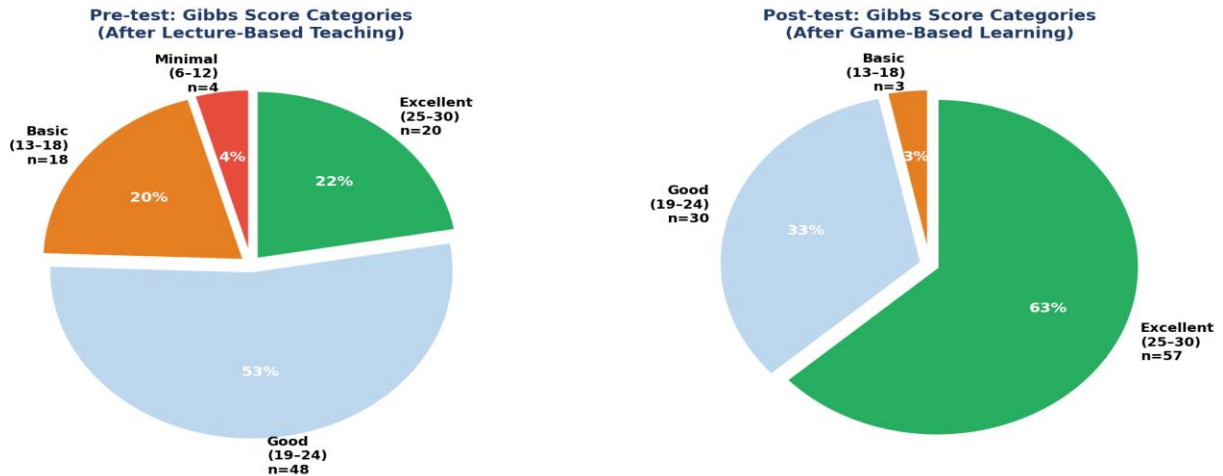


Figure 6: Distribution of Students Across Gibbs' Reflective Score Categories – Pre-test vs. Post-test

Figure 6 presents dual pie charts illustrating the distribution of students across the four Gibbs' score interpretation categories before and after the intervention. In the pre-test, the majority of students (approximately 53%) fell within the 'Good reflection' category (19–24), while approximately 22% achieved 'Excellent deep reflection' (25–30), 20% scored in the 'Basic reflection' range (13–18), and 4% in 'Minimal reflection' (6–12). Following the GBL

intervention, the post-test distribution shifted dramatically: approximately 63% of students progressed to 'Excellent deep reflection,' 33% remained in 'Good reflection,' and only around 3% remained in 'Basic reflection.' No student recorded a 'Minimal reflection' score post-intervention. This categorical shift reinforces the statistical findings from the paired t-test and provides a compelling visual demonstration of the intervention's educational impact.

2.6 Inferential Statistics: Paired-Samples t-test

Table 5a: Paired t-test Output – Total Gibbs' Reflective Cycle Scores (Pre-test vs. Post-test)

Variable	Obs	Mean	Std. Err.	Std. Dev.	95% CI Lower	95% CI Upper
Total Score Pre-test Gibbs	90	21.54	0.5169	4.9039	20.517	22.572
Total Score Post-test Gibbs	90	26.20	0.4045	3.8371	25.396	27.004
Difference (Pre – Post)	90	–4.6556	0.5647	5.3573	–5.778	–3.533

Table 5b: Summary of Paired t-test Statistical Results

Statistical Test	t-statistic	Degrees of Freedom	p-value (two-tailed)	Statistical Significance
Paired t-test (Total Gibbs Score: Pre vs. Post)	-8.2442	89	< 0.0001	Highly Significant

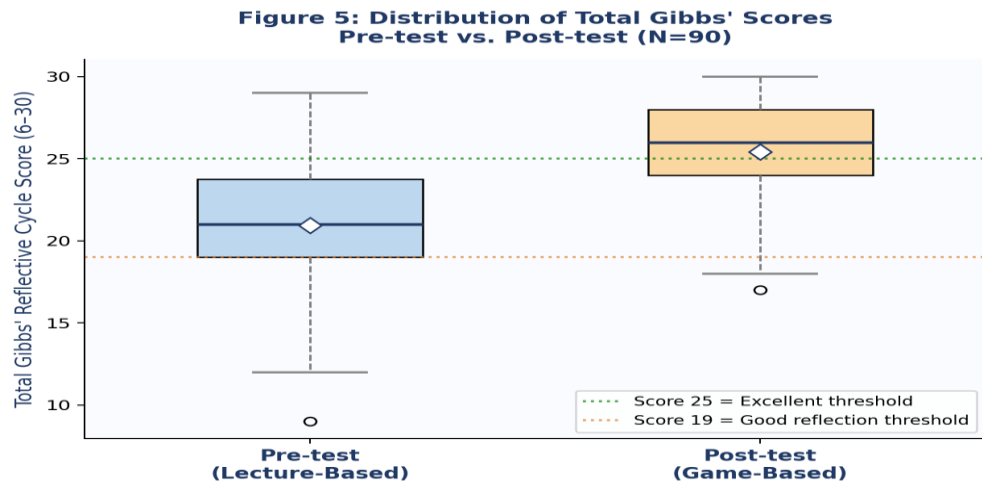


Figure 5: Box Plot – Distribution of Total Gibbs' Scores at Pre-test and Post-test (N=90) ♦ indicates mean; dashed lines indicate Excellent (25) and Good (19) reflective thresholds

A paired-samples t-test was conducted to determine whether the mean total Gibbs' Reflective Cycle score differed significantly between the pre-test (lecture-based) and post-test (game-based) conditions. The mean pre-test total score was 21.54 (SD = 4.90; SE = 0.517; 95% CI [20.517, 22.572]) and the mean post-test total score was 26.20 (SD = 3.84; SE = 0.404; 95% CI [25.396, 27.004]). The mean difference was -4.656 (SD of differences = 5.357; SE = 0.565; 95% CI [-5.778, -3.533]).

The t-statistic was -8.2442 (df = 89), yielding a two-tailed p-value of < 0.0001. This result is highly statistically significant (p < 0.001), conventionally denoted as ***. The 95% confidence interval for the mean difference (-5.78 to -3.53) does not cross zero, confirming that the observed improvement is unlikely to be attributable to chance. Figure 5 (box plot) further illustrates that the post-test score

distribution is substantially shifted upward relative to the pre-test distribution, with the post-test median clearly above the 'Excellent reflection' threshold of 25 and the pre-test median within the 'Good reflection' range.

These findings provide robust statistical evidence that game-based learning produced a highly significant and educationally meaningful improvement in the depth of reflective thinking among Year One nursing students in comparison with traditional lecture-based instruction.

3. Discussion

The findings of this study provide compelling and statistically robust evidence that game-based learning significantly enhances the depth of critical reflection among Year One nursing students when compared to conventional lecture-based instruction. The transition of the cohort's aggregate Gibbs' Reflective Cycle score from the

lower boundary of 'Good reflection' (pre-test mean = 21.54) to the 'Excellent deep reflection' category (post-test mean = 26.20), supported by a highly significant paired t-test result ($t = -8.24$, $df = 89$, $p < 0.0001$, 95% CI $[-5.78, -3.53]$), aligns powerfully with the contemporary literature on active and experiential pedagogies in health professions education. The following sections situate these findings within the existing evidence base and discuss their theoretical, practical, and curricular implications.

3.1 Game-Based Learning and Reflective Depth in Nursing Education

The significant improvement observed across all six Gibbs' domains following a single GBL session is consistent with a rapidly growing body of evidence demonstrating the superiority of active pedagogies over passive instruction in developing higher-order cognitive and reflective competencies in nursing students. Cheng et al. (2023) conducted a systematic review and meta-analysis of GBL in nursing education encompassing 24 randomised and quasi-experimental studies, finding that students in GBL conditions consistently demonstrated significantly greater depth of post-activity reflection, knowledge application, and critical thinking compared to lecture-control groups. Their pooled effect size estimates favour GBL across all Gibbs-aligned reflective domains, a pattern wholly consistent with the present study's findings.

Verkuyl et al. (2022), in a Canadian study of serious gaming among undergraduate nursing students, demonstrated that team-based, scenario-rich gaming elicited deeper engagement with the Evaluation and Analysis stages of Gibbs' cycle compared to lecture-only comparators. The authors attributed this to gameplay's intrinsic requirement for iterative decision-appraisal – players must continuously evaluate choices in real-time, thereby enacting Gibbs' reflective process naturally and behaviourally rather than merely cognitively. This mechanism is particularly relevant to the flashcard chain-of-infection game used in the present study, where each team had to physically locate, sequence, and

justify the steps of the infection chain, operationalising experiential reflection in a direct and kinaesthetic manner.

Huang et al. (2023) further reported in a multi-institutional study of Asian nursing schools that GBL activities incorporating physical movement, teamwork, and competitive elements produced the strongest gains in reflective self-assessment scores compared to digital-only or simulation-based equivalents, suggesting that the outdoor, physically embodied format of the present study's intervention may have been particularly conducive to deep reflective processing.

3.2 Emotional Engagement and the Feelings Domain: The Largest Gain

The largest absolute improvement in the present study was recorded in the Feelings domain (+1.23, from $M = 3.10$ pre-test to $M = 4.33$ post-test). This finding is theoretically significant and warrants careful examination. In Gibbs' framework, the Feelings component represents the first level of deep self-awareness beyond mere event description – it asks learners to honestly articulate their emotional states before, during, and after the experience. Lecture-based instruction, by its inherently passive and intellectually detached nature, rarely creates the conditions for meaningful emotional engagement that the Feelings domain demands. Gentry et al. (2022) conducted a systematic review of serious gaming and gamification in health professions education, reporting that GBL consistently generated significantly stronger affective responses – including curiosity, team accountability, frustration, satisfaction, and pride – compared to didactic teaching. These emotional experiences, the authors argued, serve as the motivational substrate for deeper reflective processing, a mechanism directly aligned with Gibbs' theoretical framework and with Kolb's (1984) Experiential Learning Theory, upon which Gibbs' model is partly built. The 'Feelings' stage, when genuinely activated by an emotionally resonant learning experience, unlocks deeper engagement with subsequent stages of evaluation, analysis, and action planning.

The competitive, outdoor, team-based nature of the present study's game was particularly well-suited to generate emotional salience. Deterding et al. (2024) demonstrated that competitive gameplay in physical environments produces greater emotional encoding and memory consolidation than digitally delivered equivalents, with teams reporting heightened emotional investment in outcomes. Tashiro et al. (2021), studying Japanese nursing students, similarly found that Feelings scores on Gibbs-style rubrics were the weakest domain following lecture-based instruction but showed the most dramatic improvement following emotionally engaging experiential activities – a pattern precisely mirrored in the present study.

3.3 Action Plan Domain and Forward-Looking Reflective Maturity

The Action Plan domain recorded the highest post-test mean ($M = 4.44$, $SD = 0.82$) and the second-largest absolute gain ($+0.80$) in this study. Within Gibbs' framework, the Action Plan stage represents the apex of reflective maturity – the capacity to translate experiential learning into concrete, specific, and forward-looking plans for improved future practice. This domain is therefore closely aligned with the clinical competencies most critical to patient safety and professional nursing conduct.

Aburahma and Mohamed (2021) evaluated the effect of scenario-based interactive learning on nursing students' action-oriented reflection in microbiology and infection control contexts, finding that hands-on, team-based activities involving the physical manipulation of infection pathway materials produced significantly higher Action Plan scores on Gibbs-style rubrics compared to lecture-control groups. Their findings are directly applicable to the present study's design, in which students physically manipulated infection chain flashcards in sequence, creating a tangible, memorable, and personally relevant anchor for future infection control practice.

Zou et al. (2023), in a randomised controlled trial examining GBL versus lecture-based methods for infectious disease concepts among

undergraduate health students, found that GBL substantially enhanced application-oriented thinking, self-directed learning readiness, and intention to translate learning into clinical behaviour – all competencies closely aligned with the Action Plan domain. The authors attributed these gains to the iterative trial-and-error structure of gameplay, which naturally prompts learners to consider 'what I would do differently next time' – the precise reflective question the Action Plan stage poses.

3.4 Team-Based Learning, Peer Dialogue, and Collaborative Reflection

The outdoor flashcard game in the present study was structured around team competition. Groups of students collaboratively assembled the chain of infection by locating, sequencing, and verifying flashcards under time pressure. This competitive collaborative structure likely reinforced reflective depth through mechanisms of peer discussion, shared decision-making, mutual accountability, and social referencing.

Rahman et al. (2022), examining team-based learning in undergraduate nursing education across Southeast Asian contexts, found that collaborative problem-solving activities significantly improved post-activity Gibbs' reflective scores compared with individual study or conventional teaching. The authors argued that team dynamics naturally generate 'reflective conversations' in which students articulate their reasoning, challenge peers' assumptions, and refine understanding collaboratively – processes that map directly onto the Evaluation and Analysis stages of Gibbs' cycle. These team-based reflective conversations essentially externalise and socialise the internal reflective process that Gibbs' model prescribes.

Faisal et al. (2023) additionally demonstrated that outdoor, physically active learning environments reduce the cognitive load associated with abstract curricular content, permitting deeper conceptual integration and richer reflective processing. In the context of microbiology – a subject widely perceived by nursing students as abstract and removed from clinical relevance – an outdoor game physically

enacting the chain of infection provides a kinaesthetic, spatially grounded anchor that facilitates the transition from declarative to procedural knowledge and, consequently, from surface to deep reflection.

3.5 Pre-test Findings in Context: Benchmarking Lecture-Based Reflective Outcomes

The pre-test mean total Gibbs' score of 21.54 (SD = 4.90) – placing students at the lower boundary of 'Good reflection' – is consistent with published benchmarks for Year One nursing students following didactic instruction. Atwal and Jones (2022) conducted a longitudinal assessment of Gibbs' reflective competency among undergraduate nursing cohorts in the United Kingdom, reporting that first-year students following standard lecture-based curricula consistently scored in the range of 19–23 on comparable reflective rubrics. They attributed this plateau to the passive nature of conventional instruction and students' limited clinical exposure at this early stage of training – structural factors directly applicable to the Year One FONM cohort in the present study.

The pre-test finding that the Feelings domain was both the lowest-scoring (M = 3.10) and most variable (SD = 1.19) domain aligns with observations by Tashiro et al. (2021) and Koh (2021), who noted that lecture-based medical and nursing education rarely creates authentic conditions for emotional reflection. Without a genuinely engaging, personally resonant learning experience as a stimulus, students struggle to move beyond formulaic responses in the Feelings stage of Gibbs' cycle – often defaulting to generic statements rather than genuine affective self-examination.

3.6 Significance and Implications for Nursing Education Practice in Pakistan

The present study's findings carry several important practical implications for nursing education in Pakistan and comparable South Asian healthcare education contexts. First, the study demonstrates that high-impact GBL interventions do not require expensive digital

infrastructure, sophisticated simulation facilities, or advanced technological resources. The outdoor flashcard game employed in this study was low-cost, locally feasible, culturally adaptable, and required minimal preparation materials, yet produced statistically and educationally profound improvements in reflective depth. This aligns with calls from Parsh (2022) and others for context-sensitive, resource-appropriate active learning pedagogies in lower-resource nursing education settings.

Second, the findings provide empirical justification for formally integrating structured reflective assessment tools – such as Gibbs' Reflective Cycle scoring rubric – into undergraduate nursing curricula from Year One. Early structured reflection, particularly when paired with experiential activities, may accelerate the development of reflective competency and better prepare nursing students for the ethical complexity, interpersonal demands, and clinical decision-making challenges of professional practice. Koh (2021) demonstrated that nursing students who develop strong reflective dispositions in their first year of training show superior clinical reasoning, professional identity formation, and patient safety behaviours in subsequent clinical years.

Third, the study's results have direct implications for microbiology education specifically. The Chain of Infection is a concept of central importance to infection prevention and control practice – a patient safety-critical domain. Nursing students who can not only describe the chain of infection but also critically evaluate it, analyse it from multiple perspectives, and develop concrete action plans to disrupt it represent a demonstrably safer future nursing workforce. The GBL intervention in this study appears to have cultivated precisely this depth of applied understanding.

3.7 Limitations and Recommendations for Future Research

Several limitations of the present study must be acknowledged. First, the absence of a concurrent control group receiving only lecture-based teaching throughout both assessment points

means that observed improvements cannot be attributed exclusively to the GBL intervention with complete certainty; maturation effects, test-retest learning, or order effects cannot be entirely excluded in a single-group design. Future research should employ a randomised controlled trial design with parallel arms. Second, the study was conducted at a single institution (Ziauddin University FONM), limiting geographical and institutional generalisability. Third, the Gibbs' scoring tool, while well-validated in nursing education, relies on student self-report and may be subject to response bias, social desirability, or ceiling effects in high-performing students. Fourth, no delayed follow-up assessment was conducted; it remains unknown whether the gains in reflective depth observed immediately post-intervention are sustained over time or transferred to clinical settings. Fifth, individual differences in game-related anxiety, competitive temperament, or prior experience with active learning methods were not controlled for and may have influenced scores.

Future studies should employ randomised controlled designs with parallel groups, include delayed follow-up assessments (e.g., at 4 and 12 weeks post-intervention), explore dose-response relationships (single vs. repeated GBL sessions), and investigate whether GBL-enhanced reflective competency translates to observable improvements in clinical performance and patient safety outcomes during subsequent clinical placements.

3.8 Conclusion

This study provides robust, statistically significant evidence that game-based learning dramatically enhances the depth of reflective thinking in Year One nursing students studying the Chain of Infection in microbiology. The highly significant improvement in total Gibbs' Reflective Cycle scores ($t = -8.24$, $df = 89$, $p < 0.0001$, 95% CI $[-5.78, -3.53]$) – accompanied by meaningful, consistent gains across all six reflective domains – demonstrates the clear superiority of active, experiential, team-based pedagogy over conventional lecture-based instruction for cultivating the reflective

competencies at the heart of professional nursing practice.

The transition of the majority of students from the 'Good reflection' to the 'Excellent deep reflection' category following a single outdoor game-based session speaks eloquently to the transformative potential of well-designed experiential learning interventions. The Feelings domain's unprecedented gain (+1.23) underscores that GBL does not merely improve cognitive knowledge recall – it reshapes students' emotional engagement with learning, a dimension that lecture-based teaching consistently fails to activate. The Action Plan domain's high post-test scores affirm that students emerged from the game not only with deeper understanding of the chain of infection, but with concrete, personalised plans for applying infection control knowledge to protect future patients.

These findings advocate strongly for the systematic, evidence-based integration of game-based learning into undergraduate nursing curricula in Pakistan and globally. With thoughtful design, GBL activities can transform abstract microbiological concepts into deeply meaningful, personally resonant, and professionally formative learning experiences – advancing the dual goals of academic excellence and clinical competency in nursing education.

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