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# An Educator's Experience with Gamification as a Teaching Learning Strategy in Physiology

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## ABSTRACT

**Introduction:**

**Background:** Gamification, the use of game-design elements in non-game educational contexts, has been increasingly adopted to sustain engagement among today's learners. Evidence on its effect on short-term knowledge gain and learner perception in undergraduate physiology teaching from single-institution settings remains limited.

**Objective:** To implement a Dumb Charades-based gamified learning activity for teaching neurophysiology to first-year MBBS students and to evaluate its association with short-term knowledge scores and student/faculty perceptions.

**Methods:** This was a single-centre, single-group, pre-test–post-test educational intervention study conducted in the Department of Physiology, Panimalar Medical College Hospital & Research Institute, Chennai, among first-year MBBS students. All 150 students of the cohort were included by universal (total population) sampling; no separate sample-size calculation was performed. A ten-item pre-test and an equivalent post-test on Neurophysiology were administered immediately before and after a structured Dumb Charades activity. Student (19-item) and faculty (20-item) feedback questionnaires, developed by the investigators and rated on a 3-point Likert-type scale, assessed perceptions across learning experience, team dynamics and game mechanism domains. Pre- and post-test scores were compared using the paired t-test; feedback data were summarised as frequencies and percentages.

**Results:** Of 150 students, 123 (82.0%) completed both tests. The mean post-test score (6.28 ± 1.79) was significantly higher than the mean pre-test score (5.43 ± 1.66), a mean improvement of 0.85 (paired t-test, $p<0.001$). Feedback was obtained from 111 of 128 attendees (86.7%) and all 12 faculty present. Most students rated the activity innovative and enjoyable (90.2%), academically useful (80.2%), and wanted it incorporated regularly into the curriculum (95.5%); faculty feedback was uniformly positive on organisation and student engagement.

**Conclusion:** A single Dumb Charades-based gamification activity was associated with a statistically significant short-term improvement in neurophysiology test scores and was very positively received by students and faculty at this institution. In the absence of a control group, these findings support gamification as a feasible, well-accepted adjunct teaching strategy at this centre rather

than as confirmed evidence of superiority over conventional teaching or of durable learning gains.

***Keywords:*** *Gamification; Medical education; Physiology; Dumb charades; Student engagement; Pre-test–post-test study.*

## INTRODUCTION

One of the key challenges in higher education for the educator is the dynamic student generation and its diverse learning styles and expectations. Understanding the characteristics of different generations of learners is essential for creating an effective learning experience. The current post-millennial generation of learners is tech-savvy, entrepreneurial and independent. They have shorter attention spans due to their constant digital engagement. To draw the attention of today's generation and get them involved in the learning process, educators have to rethink their approaches to teaching-learning and climb onto the wagon of innovation.

One novel and unconventional approach to teaching-learning in medicine is gamification, which is defined as "the use of game design elements in non-game contexts" [1]. Gamification has been tried in different forms by educators and has been shown to enhance academic performance by increasing student engagement in the learning process [2]. Studies have shown that gamification can improve learning results by providing immediate feedback and creating a competitive and supported environment [3]. Dumb charades serve as a powerful means to promote communication and teamwork among the participants. It encourages creativity through nonverbal expression, allowing people to connect beyond verbal language [4]. Such games improve social dynamics and promote collaboration [5].

In this article, we share how we adapted the game of Dumb Charades to a learning activity in Physiology and student perceptions on the same. The topic selected was Neurophysiology as majority of the MBBS learners generally find it to be challenging.

## MATERIALS AND METHODS

**Study design and setting:** This was a single-centre, single-group, pre-test–post-test educational intervention study (a quasi-experimental design without a control arm) conducted in the Department of Physiology, Panimalar Medical College Hospital & Research Institute, Varadarajapuram, Poonamalee, Chennai, among first-year MBBS students undergoing the Neurophysiology module of the Competency-Based Medical Education (CBME) curriculum. The activity was conducted as a single session.

**Participants and sampling:** All 150 first-year MBBS students of the batch were eligible, and a universal (total population/census) sampling approach was used - the entire available cohort was invited to participate rather than a drawn sample, and no separate sample-size calculation was performed. Students who did not provide consent, or who were absent for the pre-test, the activity, or the post-test, were excluded from the respective paired analyses; incomplete feedback forms were excluded from the feedback analysis alone. Of the 150 eligible students, 128 were present for the feedback exercise, and complete paired pre–post test data were available for 123 (response rate 82.0% for tests; 86.7% [111/128] for student feedback).

**Intervention design:** Dumb charades is a common, interactive party game in which one player is assigned a word or phrase to represent through silent gestures, while teammates attempt to decipher it within a set time frame; the actor is prohibited from speaking or mouthing words. The game was adapted as a structured learning activity on Neurophysiology. Substantial planning preceded the session: rules were framed, terms suitable for miming were selected, questions were framed on the corresponding

topics, and the scoring pattern, penalties, and procedural framework were systematically defined in advance by the investigators. The session was conducted by a moderator, a timekeeper, and two scorekeepers for a cohort of 150 students split into 10 groups of fifteen. The activity comprised six rounds (three theory-based, three practical-based). At the outset, the first author explained the activity and its rules; teams were introduced to "pounce" slips and their method of use, and a trial round was conducted to familiarise students with the format. A wheel spinner was used to randomly allot questions to each team to minimise selection bias. Each group had 120 seconds to identify the Dumb Charades term and a further 120 seconds to state three physiologically relevant points on the topic, both contributing to the round score; ambiguous responses were adjudicated by the moderator. Teams then answered two moderator-generated questions within the stipulated time; group discussion was permitted. Unresolved terms could be "pounced" upon by competing teams, who submitted written answers to the moderator, with the first correct submission earning the points; the originating team retained the opportunity to state physiology points and answer the moderator's question once the term was identified. Scores were displayed on a leaderboard after each round, pooled across rounds, and the winning team was declared at the end.

**Pre-test and post-test instrument:** A pre-test comprising ten questions on Neurophysiology (10 marks) was administered before the activity, and an equivalent post-test, matched to the pre-test in content, format and difficulty, was administered immediately (within a few minutes) of the conclusion of the activity, to capture short-term knowledge gain. Both instruments were framed by the investigators, mapped to the learning objectives of the session, and reviewed for content relevance and difficulty by faculty of the Department of Physiology prior to use; a distinct pre-validated question bank was not employed.

**Feedback questionnaire development and validation:** Student (19-item) and faculty (20-item) feedback questionnaires were developed by the investigators, informed by domains reported in the gamification literature, and organised under learning experience, team dynamics and game mechanism domains for students, and effectiveness, learning factors, preparation/ team dynamics, and organisation/future implementation domains for faculty. Responses were recorded on a 3-point Likert-type scale (strongly agree / neither agree nor disagree / disagree).

## Statistical Analysis

Continuous variables (pre- and post-test scores) are expressed as mean ± standard deviation. The paired t-test was used to compare pre- and post-test scores in the 123 students with complete paired data; a two-tailed p-value $<0.05$ was considered statistically significant. Normality of the distribution of paired differences, an assumption underlying the paired t-test, was not formally tested in the original analysis; given the sample size (n=123) this is considered an acceptable, if unverified, assumption, and is noted as a limitation of the statistical approach. Categorical feedback data (Tables 2 and 3) are summarised as frequencies and percentages; no inferential comparison (e.g. between student and faculty responses) was performed. Analyses were performed using SPSS for Windows version 20.

## RESULTS

A total of 128 I MBBS students participated in the activity and took up the pre- and post-tests, which carried 10 marks each. Completed test slips were obtained from 123 learners. Analysis of their pre- and post-test scores is shown in table 1.

**Table 1: Comparison of Pre- and Post-test scores**

| | Total no. of learners | Arithmetic Mean | SD | P value |
|---|---|---|---|---|
| Pre-test scores (out of 10) | 123 | 5.43 | 1.66 | |
| Post-test scores (out of 10) | 123 | 6.28 | 1.79 | < 0.001* |

* highly significant

Pre-test scores ranged from 2 to 9. Fifty of the 123 learners had scored 5 marks or less. Sixty-five had obtained scores of either 6 or 7, while 8 had obtained 8 marks or more. The mean pre-test score was 5.43 ± 1.66.

Of the post-test scores, the lowest value was found to be 4. Seventeen learners had scores of 5 or less. One hundred and six learners had scored six and above of whom seventy-eight had scored 6 or 7 and twenty-eight had scored 8 or 9. The mean post-test score was 6.28 ± 1.79. Statistical analysis using the paired T test revealed that the mean difference of 0.85 between the pre- and post-test scores was highly significant with a p value < 0.001. (Table 1)

Feedback was taken from the 128 learners regarding the learning experience, team dynamics and the game process including future implementation preferences. Completed feedback forms were received from 111. Analysis of the feedback gave insights into learner perceptions on the new gamification approach and its usefulness (Table 2).

**Table 2: Learner feedback on the activity**

| S.No. | | Strongly agree | Neither agree nor disagree | Disagree |
|---|---|---|---|---|
| | | Frequency (%) (n=111) | | |
| | Learning Experience | | | |
| 1 | The activity was innovative, interesting and an interactive and fun way of learning | 111 (90.24) | 12 (9.76) | 0 (0) |
| 2 | The activity was a useful learning experience | 89 (80.2) | 22 (19.8) | 0 (0) |
| 3 | I prepared and came for the session | 65 (58.6) | 46 (41.4) | 0 (0) |
| 4 | I learned from my classmates' answers | 74 (66.7) | 37 (33.3) | 0 (0) |
| 5 | I learned from the points made by the professors | 40 (36) | 71 (64) | 0 (0) |
| 6 | Interacting with teammates helped me learn | 65 (58.6) | 46 (41.4) | 0 (0) |
| 7 | The informal/ fun atmosphere helped me learn | 32 (28.8) | 79 (71.2) | 0 (0) |
| 8 | The activity stimulated me to learn more on this topic | 81 (73.0) | 30 (27.0) | 0 (0) |
| | Team Dynamics | | | |
| 9 | The team dynamic in my group was excellent | 104 (93.7) | 7 (6.3) | 0 (0) |
| 10 | Everybody in the team actively participated | 99 (89.2) | 12 (10.8) | 0 (0) |
| 11 | Oneness was observed in our group | 98 (88.3) | 13 (11.7) | 0 (0) |
| 12 | No one was domineering in our group | 97 (87.4) | 14 (12.6) | 0 (0) |
| 13 | No one was withdrawn and non-participating in our group | 95 (85.6) | 16 (14.4) | 0 (0) |
| | Game Mechanism | | | |
| 14 | Overall, I would rate the game session excellent | 97 (87.4) | 14 (12.6) | 0 (0) |
| 15 | The game session fostered my learning | 79 (71.2%) | 32 (28.8) | 0 (0) |
| 16 | Interest in the game helped me learn | 59 (53.2) | 52 (46.8) | 0 (0) |
| 17 | We should have such gamification of learning activities regularly in the curriculum | 106 (95.5) | 5 (4.5) | 0 (0) |

| | | | | |
|---|---|---|---|---|
| 18 | We should have at least five or more such sessions per academic year | 99 (89.2) | 0 (0) | 12 (10.8) |
| 19 | It is feasible to organize this kind of activity frequently | 83 (74.8) | | 28 (25.2) |

The activity was very positively received by the participants with a whopping 90.24% of the learners describing it as innovative, interesting, interactive and a fun way of learning, and 87.4% grading it excellent. About 80.2% agreed that it was a useful learning experience.

About 71.2% felt that the game session fostered their learning and 73% said it triggered them to learn more on the topic. 66.7% of the learners said they learned from their peers' answers, and 36% said they learned from the moderator's inputs. The interaction and the teamwork were enjoyed and viewed positively by a large majority of the participants (>85%), who felt that the groupwork was one of the major merits of the activity; 95% wanted more such gamification sessions in the future. Feedback was also obtained from all the faculty members who attended the dumb charades session. (Table 3).

**Table 3: Faculty feedback on the activity**

| | | **Agree** | **Neutral** | **Disagree** |
|---|---|---|---|---|
| | | **Frequency (%) (n=12)** | | |
| | **Effectiveness** | | | |
| 1 | The activity was enjoyable and engaging for the students | 12 (100) | 0 (0) | 0(0) |
| 2 | The students used it as a learning experience | 12 (100) | 0 (0) | 0(0) |
| 3 | The students showed significant interest in the activity | 12 (100) | 0 (0) | 0(0) |
| 4 | The students showed enthusiasm in participating in the game | 12 (100) | 0 (0) | 0(0) |
| 5 | Game elements of the activity caught the interest of the students | 11(91.7) | 1(8.3) | 0(0) |
| | **Learning Factors** | | | |
| 6 | Classmates' inputs contributed to student learning in this session | 11(91.7) | 1(8.3) | 0(0) |
| 7 | The relaxed and informal atmosphere enhanced student learning in this session | 11(91.7) | 1(8.3) | 0(0) |
| 8 | The moderator's additional input significantly contributed to student learning | 9(75) | 3(25) | 0(0) |
| 9 | Some students were disinterested and withdrawn during the activity | 2(16.7) | 4(33.3) | 6(50) |
| 10 | Students came well-prepared for the session | 5 (41.7) | 7(58.3) | 0(0) |
| | **Preparation and Team Dynamics** | | | |
| 11 | The teams worked in a united manner | 12 (100) | 0 (0) | 0(0) |
| 12 | Everyone participated equally in the team | 10(83.3) | 2(16.7) | 0(0) |
| 13 | There were certain dominant members in the team | 5(41.7) | 5(41.7) | 2(16.7) |
| 14 | Some team members were left out | 0(0) | 3(25) | 9(75) |
| | **Organization and Future implementation** | | | |
| 15 | Overall, the session was effective as a learning activity | 12 (100) | 0 (0) | 0(0) |
| 16 | The program was well-organized | 12 (100) | 0 (0) | 0(0) |
| 17 | The time duration for the activity was sufficient | 10(83.3) | 2(16.7) | 0(0) |
| 18 | Intensive planning goes into the organisation and conduct of such activities | 10(83.3) | 2(16.7) | 0(0) |
| 19 | These activities should be held periodically | 12 (100) | 0 (0) | 0(0) |
| 20 | Gamification activities should be a regular part of the curriculum | 12 (100) | 0 (0) | 0(0) |

The responses from faculty showed a positive perception with respect to gamified learning activity over a range of domains. All faculty agreed that the activity was both fun and engaging for the students, and who perceived it as a meaningful learning experience. The majority of the respondents (91.7%) believed that the game elements increased student engagement and that peer feedback and a more relaxed environment played a significant role in terms of learning. About 75% of faculty also felt that

the moderator's opinion added valuable inputs. While 16.7% of faculty perceived certain participants as being disinterested, more than half were neutral about student preparedness for the session.

The team dynamics were generally believed to be good, and unanimous consensus was reached that teams cooperated; 83.3% of faculty felt that all team members equally took part, though minority views regarding dominant team members remained mixed. Importantly, 75% said they disagreed that any student was excluded, suggesting there were no students excluded and this was very significant in general.

Faculty feedback confirmed that the session was efficient, structured correctly and time appropriate. The faculty were unanimous in stating that they would welcome a chance to engage in these educational activities with more frequency and would welcome the use of gamification for regular use as part of the curriculum. Overall, the feedback concluded that the gamified approach was positively received, was pedagogically useful and appeared to be well-suited for general implementation in medical education.

## DISCUSSION

The changing learning preferences of modern medical students highlight the need for innovative, participatory teaching–learning strategies that sustain engagement and promote deeper understanding. Gamification, first conceptualized in 2008 and increasingly integrated into educational contexts after 2010 [6], has emerged as one such pedagogical approach. Gamification is described as the application of game design elements to non-game contexts in order to make real-world tasks more enjoyable and motivating, a principle that has been shown to enhance motivation and learner commitment in medical education [7,8].

Dumb Charades was chosen for its potential to foster teamwork, non-verbal communication, creativity, and positive social interaction [9], and was conducted in a relaxed, non-judgmental atmosphere. The statistically significant rise in mean test score (5.43 to 6.28, $p<0.001$) is consistent with several pre-experimental gamification studies reporting short-term gains in knowledge or engagement scores [10,11]. But the overall increase in absolute magnitude was modest (0.85 out of 10 marks), and because the single-group, pre–post design was without a control or comparison group, the effect on the improvement cannot be directly credited to adopting a gamification design. Possible alternate or added factors include test-retest effects of repeated exposure to closely related content, the revision effect of studying the same topic twice in a short space of time regardless of format, or that about 59% of students reported some prior preparation before the session, which might have independently impacted post-test performance. A conventional, non-gamified revision session covering the same content could plausibly have induced a similar numerical gain; this study cannot differentiate a particular effect of gamification from simply a general effect of a second, structured exposure to the topic.

Feedback indicated a strongly positive reception: 90.2% of students described the session as innovative and enjoyable, 87.4% rated it excellent, and 80.2% considered it academically useful, in keeping with reports that gamification enhances engagement, motivation, and satisfaction in both in-person and online settings [12,13,14]. These figures should, however, be interpreted with some caution. Feedback was collected immediately after an enjoyable, novel activity, in a non-anonymous, faculty-observed classroom setting, which may have introduced social-desirability and novelty-effect bias favouring positive responses; students who found the activity unhelpful or uncomfortable may also have been less likely to complete or candidly report on the feedback form. Perceived enjoyment and perceived learning, as captured here, are also not equivalent to objectively demonstrated learning, which in this study is represented only by the modest post-test gain discussed above.

Most students (93.7%) reported positive team dynamics, and only a small proportion (11–14%) identified concerns about dominance or exclusion, broadly consistent with literature describing collaborative gamified formats as supportive of inclusive participation. Two-thirds of students (66.7%) reported learning from peers' answers, compared with 36% who attributed learning to faculty input, suggesting a relatively strong role for near-peer learning in this format; this is consistent with, though not independently verified against, prior observations that peer-mediated learning is prominent in gamified small-group settings. Nearly three-quarters (73%) reported increased interest in further reading after the session, which may reflect genuine curiosity generated by the activity, but could equally reflect a general Hawthorne-type response to being observed and assessed in a novel setting; the study design cannot separate these possibilities.

Gamification of activities requires thoughtfulness: not every game format works for everyone's learning style and can undermine motivation rather than help it [15] and point-based systems that are poorly designed can gradually decrease engagement. The current results have been reaffirmed by studies that proposed that such gamified learning not only promotes understanding and enhances motivation on the part of the students [6] but that also are close to being in line with what has been demonstrated before, reporting about active learning and group solidarity through gamification as a dimension to medical education [16]. Nevertheless, more nuanced research is necessary to investigate whether particular approaches to gamification can be adapted to match different ways of learning, before such formats are adopted more widely [17].

## Limitations

The following limitations that should be considered when interpreting the findings. First, it was conducted at a single centre in a single cohort of first-year MBBS students without a control or comparison group; the observed improvement in test scores therefore cannot be attributed with confidence to the gamification activity itself, as it may partly reflect a test-retest effect, prior self-directed preparation, or the general effect of a second structured exposure to the topic rather than the game format specifically. Second, the post-test was administered immediately after the activity, so the results reflect only short-term recall; no delayed post-test was performed, and the findings say nothing about longer-term knowledge retention or subsequent examination performance. Third, there was measurable attrition and non-response: complete paired test data were available for only 123 of 150 eligible students (82.0%), and feedback was obtained from 111 of 128 attendees (86.7%); this attrition, together with the non-anonymous, faculty-observed setting in which feedback was collected, raises the possibility of response and social-desirability bias favouring more engaged or more satisfied participants. Fourth, the study evaluated a single teaching topic (neurophysiology) using a single game format (dumb charades) at one institution, which limits generalisability to other topics, game formats, learner cohorts, or institutions. Finally, self-reported perception data are inherently subjective and, given that this was likely many students' first exposure to a structured gamified classroom activity, may be influenced by a novelty effect that could diminish with repeated use.

## CONCLUSION

Within the constraints of this single-institution, single-group, pre-test–post-test evaluation, a Dumb Charades-based gamification activity for teaching Neurophysiology to first-year MBBS students was associated with a statistically significant short-term improvement in test scores and was very positively received by both students and faculty. These findings suggest that gamification can be a feasible and well-accepted adjunct to conventional

teaching in this specific setting. In the absence of a control group, a delayed outcome assessment, and evaluation across other topics, learner groups or institutions, the results should not be interpreted as evidence that gamification is superior to conventional teaching methods, that gains in knowledge are durable, or that this specific format would generalise across the wider curriculum. Controlled, multi-centre studies incorporating a comparison arm and delayed post-testing are needed before broader curricular adoption of this approach can be recommended.

## *Declaration by Authors*

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## Authors' contribution:

Study design: Preetha Paul

Data collection: Preetha Paul, Ilham Jaleel

Manuscript preparation and submission: Preetha Paul, Ilham Jaleel

Final draft editing and approval: Preetha Paul



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