

Effectiveness and Acceptability of Digital Gamified Learning in Community Medicine among Medical Undergraduates: A Quantitative Quasi-Experimental Study

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KEYWORDS <i>Community medicine; digital learning; gamification; health education; medical education; undergraduate medical students.</i> Received on: 18-08-2026 Accepted on: 20-09-2026 Published on: 07-10-2026	ABSTRACT Background: Gamified learning is the use of gaming components like scoring, time-bound tests, ranking, scores, and instant feedback for educational purposes. Gamification in medical education could enhance engagement, motivation, focus, and learning reinforcement in students. This paper evaluates the effectiveness and acceptability of digital gamified learning in community medicine among undergraduate medical students. Methods: The effectiveness of digital gamified learning on community medicine was measured using a quantitative one-group pre-test/post-test quasi-experimental design. The study was conducted among 184 undergraduate medical students in the Department of Community Medicine in a tertiary care centre at Puducherry, India, between January and March 2026. Three quiz-based digital gamified learning sessions were conducted using the Quizizz platform. Knowledge was assessed using a 15-item multiple-choice questionnaire before and immediately after the gamified learning session. Students' perceptions and platform acceptability were assessed using a structured five-point Likert-scale questionnaire. Data were analyzed using Jamovi version 2.3. Paired t-test and Pearson Chi-square test were applied as appropriate. A P value <0.05 was considered statistically significant. Results: The mean pre-test knowledge score was 6.18 ± 1.83 that rose to 10.94 ± 1.92 after gamified learning. There was an improvement of 4.76 marks (95% CI: 4.43-5.09; $P < 0.001$). Good knowledge level rose from 6.5% prior to gamified learning intervention to 50.5%. Majority of participants agreed/strongly agreed that gamified learning was fun (88.6%), raised interest in learning (86.4%), increased focus during class sessions (84.8%), was more engaging than normal classroom teaching (85.9%), and helped retaining the topic well (82.6%). There was a statistical significance between favorable perception and the MBBS phase ($P = 0.034$) and post-test knowledge category ($P = 0.004$). A significant relationship was noted between favorable perception and attendance of two or more sessions, but no statistical significance could be found ($P = 0.055$). Conclusion: Digital gamified learning led to significant improvement in immediate knowledge scores and was perceived favorably by medical undergraduates. It could be used as an adjunct to conventional teaching methods in community medicine, particularly formative assessments and revision sessions.
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INTRODUCTION

Medical education has evolved from being passive and teacher-centered to more interactive and learner-centered and assisted by technology. Although traditional lecture-based teaching is still relevant to impart basic

information, it may lose its interest and appeal to the students if their interaction with the course is restricted. In subjects like community medicine, which demand understanding of epidemiology, national health programs,

preventive measures, and application of public health in real-life scenarios, active learning might prove beneficial.^{1,2}

Gamification implies using gaming elements in non-gaming environments. In education, gamified learning involves points, badges, leaderboards, ranking, progress indicators, timed activities, feedback, and rewards.^{1,3}

Digital platforms have made the application of gamification in a large classroom easy by providing facilities such as real-time participation, scoring, quick feedback, and data storage. These qualities might facilitate formative assessment, quick correction of any misconception and reinforcement of key concepts.^{4,5}

Gamification has been used in a number of health professions education disciplines for activities like formative assessment, revision, problem-solving, and skill-based learning. Previous studies have found that because gamified learning is interactive, students find it enjoyable.⁶⁻⁸

However, the majority of the literature has focused on students' perceptions, and fewer studies have quantitatively assessed the acceptability and knowledge acquisition of this kind of learning. There is little evidence of digital gamification for community medicine in the literature.⁹⁻¹⁰ Additionally recent research has highlighted the value of competency-based modules, structured

educational interventions, active learning strategies in enhancing medical students' knowledge acquisition and application.^{11,12}

Gamified learning in community medicine provides opportunities such as quizzes about the epidemiological aspects, outbreak investigation, screening methods, national health programs, maternal and child health, environmental health, and biostatistics. Considering the fact that competency-based medical education stresses on active learning, self-directed learning, formative assessment and feedback, digital gamification could be an effective supplement to conventional teaching methods.¹³⁻¹⁵

Hence, the present study was carried out to measure the effectiveness and acceptability of digital gamified learning in community medicine.

OBJECTIVES

Primary objective

To compare knowledge scores of medical undergraduates before and after digital gamified learning sessions in community medicine.

Secondary objectives

1. To assess students' perceptions regarding digital gamified learning in community medicine.
2. To assess students' acceptability of the digital platform used for gamified learning.

3. To determine selected factors associated with favorable perception toward gamified learning.

MATERIALS AND METHODS

A quantitative one-group pre-test/post-test quasi-experimental research was carried out in the Department of Community Medicine in a tertiary care centre at Puducherry, India within a period of three months between January and March 2026. The study population included Phase II and Phase III Part I MBBS students who were attending community medicine classes during the study period.

Students enrolled in Phase II or Phase III Part I MBBS, attended at least one digital gamified learning session in community medicine, completed the required pre-test and post-test, completed the feedback questionnaire, and provided informed consent were included in our study. Students, who did not attend the intervention, filled up the incomplete questionnaire or consent was not obtained, were not included in the study.

The study participants were 184 medical undergraduates who qualified for inclusion criteria set for the period. Since the study was conducted as an educational intervention among the available academic batches, complete enumeration of all eligible students was attempted. Therefore, a formal sample size calculation was not performed, and all eligible consenting students with

complete responses were included in the final analysis (n = 184).

Study intervention

Digital gamified learning was introduced as an adjunct to routine community medicine teaching. A total of three gamified learning sessions were conducted over the study period. Each session corresponded to a different community medicine topic taught during routine classroom teaching. The topics included epidemiology of communicable diseases, National Tuberculosis Elimination Programme, and outbreak investigation. These topics were selected because they are important components of the undergraduate community medicine curriculum and require both conceptual understanding and application of public health principles.

At the end of the intervention, students were supposed to remember crucial concepts about the topic, comprehend public health principles, interpret basic community medicine scenarios, and apply these concepts into practical problems. Each gamified intervention took about 20 minutes and comprised of 15 multiple choice questions.

The intervention was performed via the Quizizz digital platform. Before the first intervention session, students were given a brief orientation training regarding the use of Quizizz, including how to access the platform, enter the game code, submit responses, view feedback, and interpret scores.

Students used their personal smartphones for taking part in the study. The internet was provided by institutional Wi-Fi and/or personal mobile data during the intervention. The technical assistance was provided during the activity in case of any trouble with logging in and accessing the internet. The intervention included game elements such as time response, immediate feedback, auto-scoring, displaying leader boards, ranking, and question discussion by faculty. At the end of each quiz, the correct answers were discussed by the faculty member for reinforcing learning and clarification of concepts. All sessions were done by the same faculty member to avoid any instructor-specific variation. Students attended sessions according to routine class attendance; therefore, some students attended one session, some attended two sessions, and others attended all three sessions.

Pre-test and post-test procedure

Before the commencement of each gamified learning session, participants completed a pre-test consisting of 15 multiple-choice questions related to the topic. Immediately after completion of the gamified activity and faculty-led discussion, the same 15-item questionnaire was administered as a post-test to assess immediate knowledge gain.

For students attending more than one session, only the first complete paired pre-test and post-test response was included in the pre-test/post-test analysis to avoid repeated observations from the same participant. Session attendance was retained as a categorical exposure variable for perception analysis.

Study tool

Data were collected through a structured questionnaire which had four parts.

Part A: Demographics and academic information such as age, gender, MBBS year, experience in the use of digital quiz platform, and participation in the gamified quizzes.

Part B: Assessment of knowledge through a 15 item multiple choice questionnaire. One point was allocated for every correct answer and zero points for every incorrect answer. The maximum possible score was 15. Knowledge scores were categorized using predefined operational cut-offs as poor knowledge (<50%), average knowledge (50-74%), and good knowledge ($\geq 75\%$).

Section C: Perception regarding gamified learning using a five-point Likert scale. Responses ranged from 1 = strongly disagree to 5 = strongly agree. Scores of 4 and 5 were considered favorable responses for item-wise analysis. Overall favorable perception was defined as an overall perception score of $\geq 75\%$.

Section D: Platform acceptability using a five-point Likert scale and an overall platform score out of 10.

Questionnaire validation and reliability

The questionnaire was validated for face and content validity through the review of three community medicine faculty members and one medical education faculty member. The knowledge questionnaire was independently reviewed for the content validity, clarity, difficulty, and compliance with the pre-defined learning objectives before administering it. The multiple-choice questions included recall, understanding, and application-based questions pertaining to the subjects taught in the teaching sessions. This approach was similar to other structured educational intervention studies where assessment tools and learning materials were reviewed for relevance, clarity, and alignment with intended learning outcomes before implementation.^{11,12}

Pilot testing was done among 20 students not included in the data analysis. Minor changes were made in the wording of the questionnaire based on the feedback of pilot-testing participants. Cronbach's alpha for the perception questionnaire was 0.91, indicating good internal consistency.

Data Collection Procedure

Students were informed about the purpose of the study, voluntary participation, confidentiality, and anonymity of responses.

After informed consent, students completed the pre-test before the gamified learning session. Routine teaching was followed by the digital gamified quiz, immediate post-test, perception questionnaire, and platform acceptability questionnaire. The perception and platform acceptability questionnaire was administered once to each participant after the participant's final attended gamified learning session during the study period.

Data were collected using Google Forms and exported to Microsoft Excel for cleaning before analysis. Each participant entered a unique study identification number linked to the institutional roll number. Google Forms was configured to accept only one response per participant for the final perception questionnaire, and duplicate entries were manually screened before data analysis. In case of repeated or incomplete submissions, only the first complete response was retained for analysis.

STATISTICAL ANALYSIS

Data were analyzed using Jamovi version 2.3. Continuous variables were expressed as mean and standard deviation or median and interquartile range depending on data distribution. Categorical variables were expressed as frequency and percentage. Normality of continuous variables and paired score differences was assessed using the Shapiro–Wilk test. Since the paired differences in pre-test and post-test knowledge

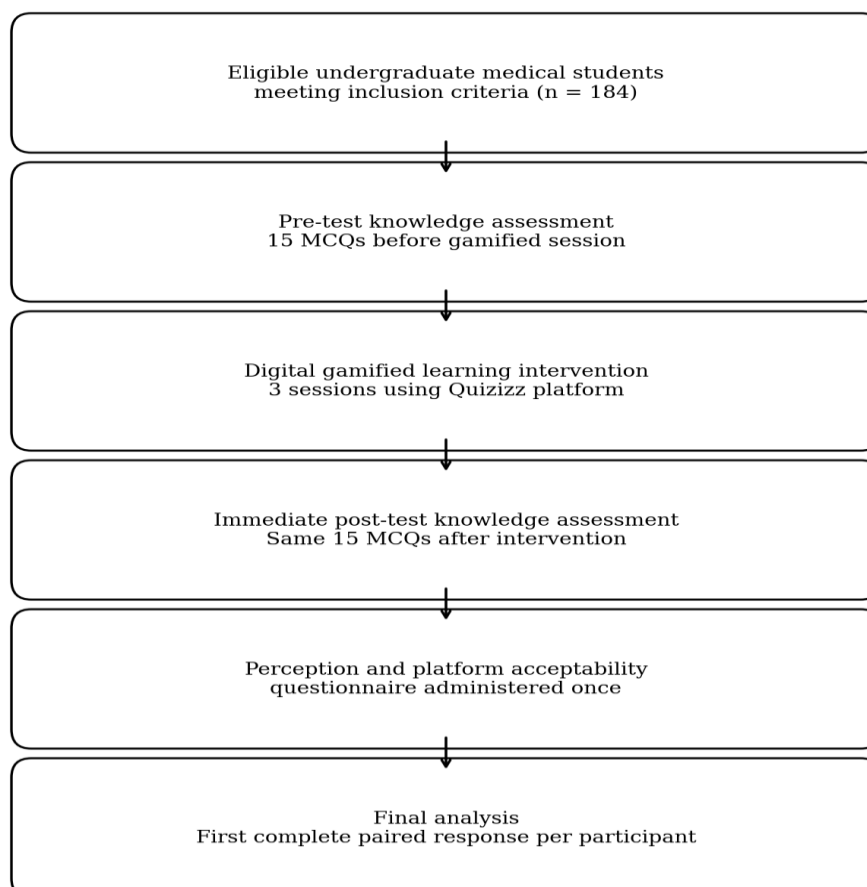
scores were approximately normally distributed, paired t-test was used to compare mean knowledge scores before and after the intervention. Effect size was estimated using Cohen's d. Pearson's Chi-square test was conducted to check the association of selected categorical variables with positive perception toward gamification. Two sided P value <0.05 was considered to be statistically significant.

Ethical Considerations

The research received approval from the Institutional Ethics Committee of Sri

Venkateswaraa Medical College Hospital and Research Centre, Puducherry, with Institutional ethics committee no. SVMCH/IEC/2026/047 on 04 January 2026. Participation in the study was completely voluntary. Informed consent was taken from all participants. Anonymity of the responses was ensured. Students were made aware that participation and non-participation in the study will not have any effect on their academics. Flowchart of the study was given in figure 1.

Figure 1. Study flow diagram



MCQ: multiple-choice questions

RESULTS

Participant characteristics

Total number of students in the study was 184. Mean age of the subjects in the study was 21.4 ± 1.1 years. Among the participants, 84 (45.7%) were males while 100 (54.3%)

were females. There were equal numbers of students belonging to Phase II and Phase III Part I, which was 92 students in each. Previous experience of using digital quiz platform was seen in 132 (71.7%) students (Table 1).

Table 1: Sociodemographic and academic characteristics of study participants (n = 184)

Characteristics	Frequency (n)	Percentage (%)
Age group		
<20 years	18	9.8
20-22 years	136	73.9
>22 years	30	16.3
Gender		
Male	84	45.7
Female	100	54.3
MBBS phase		
Phase II	92	50.0
Phase III Part I	92	50.0
Previous exposure to digital quiz platforms		
Yes	132	71.7
No	52	28.3
Number of gamified sessions attended		
One session	48	26.1
Two sessions	74	40.2
Three or more sessions	62	33.7

Table 2: Comparison of pre-test and post-test knowledge scores among study participants

Variable	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	Mean difference	95% CI of mean difference	t value	P value	Effect size (Cohen's d)
Knowledge score (maximum score = 15)	6.18 $\pm$ 1.83	10.94 $\pm$ 1.92	4.76	4.43-5.09	28.31	<0.001	2.09

Paired t-test was used because paired differences were approximately normally distributed.

The average pre-test score obtained was 6.18 ± 1.83 out of 15, and the mean post-test score was 10.94 ± 1.92 . The mean increase in knowledge score was 4.76 marks

(95% CI: 4.43-5.09). The difference was statistically significant, with paired $t = 28.31$ and $P < 0.001$. The effect size of the study was very large (Cohen's $d = 2.09$) (Table 2).

Table 3. Distribution of students according to knowledge category before and after gamified learning

Knowledge category	Pre-test n (%)	Post-test n (%)
Poor knowledge (<50%)	99 (53.8)	16 (8.7)
Average knowledge (50-74%)	73 (39.7)	75 (40.8)
Good knowledge ($\geq 75\%$)	12 (6.5)	93 (50.5)
Total	184 (100.0)	184 (100.0)

Knowledge categories were based on predefined operational cut-offs. No ordinary

Prior to intervention, the number of students with good knowledge scores was 12 (6.5%). Post-intervention, 93 (50.5%) students obtained good knowledge scores. The

Chi-square test was applied to this paired pre-test/post-test categorical table.

percentage of students with poor knowledge was reduced from 53.8% pre-intervention to 8.7% post-intervention (Table 3).

Table 4. Students' perceptions regarding digital gamified learning

Perception item	Agree/strongly agree n (%)	Median score (IQR)
Gamified learning was enjoyable	163 (88.6)	5 (4-5)
It increased my interest in learning community medicine	159 (86.4)	5 (4-5)
It kept me attentive during class	156 (84.8)	5 (4-5)
It made the class more engaging than routine lectures	158 (85.9)	5 (4-5)
It helped me understand difficult concepts	151 (82.1)	4 (4-5)
It helped me retain the topic better	152 (82.6)	4 (4-5)
It motivated me to read more about the topic	146 (79.3)	4 (4-5)
It improved my confidence in answering MCQs	150 (81.5)	4 (4-5)
Competition motivated me to perform better	154 (83.7)	5 (4-5)
It improved interaction with faculty	149 (81.0)	4 (4-5)
I am satisfied with gamified learning	161 (87.5)	5 (4-5)
I recommend using gamification in future community medicine classes	160 (87.0)	5 (4-5)

Responses were recorded on a five-point Likert scale. Scores of 4 and 5 were

Most students had a positive perception regarding gamified learning. In general, 163 (88.6%) students strongly agreed that gamified learning was fun. 159 (86.4%) felt that gamified learning increased their interest in

considered favorable responses

learning community medicine, while 158 (85.9%) felt that gamified learning class was more exciting than regular lectures. Median overall satisfaction was 5.0 (IQR: 4.0-5.0) (Table 4).

Table 5A: Students' acceptability of the digital platform used for gamified learning

Platform acceptability item	Favorable response n (%)	Neutral/unfavorable response n (%)	Median score (IQR)
Easy to log into the platform	165 (89.7)	19 (10.3)	5 (4-5)
Easy to navigate during the quiz	164 (89.1)	20 (10.9)	5 (4-5)
Easy to submit answers	167 (90.8)	17 (9.2)	5 (4-5)
Satisfactory visual appearance	153 (83.2)	31 (16.8)	4 (4-5)
Enjoyed using the platform	161 (87.5)	23 (12.5)	5 (4-5)
Overall platform score out of 10	Mean score: 8.3 ± 1.3	Range: 5-10	9 (8-9)

Favorable response for Likert-scale items included scores of 4 and 5. Overall platform score was recorded on a 0-10 scale.

Most students found the digital platform user-friendly. Easy login facility was found by 165 (89.7%) students, easy navigation by 164 (89.1%) students, and easy submission of answers by 167 (90.8%)

students. The mean overall platform score was 8.3 ± 1.3 out of 10, while the median score was 9.0 (IQR: 8.0–9.0) indicating acceptable overall perception of the digital platform (Table 5A).

Table 5B: Factors associated with favorable perception toward gamified learning

Variable	Category	Favorable perception n (%)	Neutral/unfavorable perception n (%)	P value
Gender	Male	68 (80.9)	16 (19.1)	0.710
	Female	83 (83.0)	17 (17.0)	
MBBS phase	Phase II	81 (88.0)	11 (12.0)	0.034
	Phase III Part I	70 (76.1)	22 (23.9)	
Previous exposure to digital quiz platforms	Yes	112 (84.8)	20 (15.2)	0.116
	No	39 (75.0)	13 (25.0)	
Number of sessions attended	One session	35 (72.9)	13 (27.1)	0.055
	Two or more sessions	116 (85.3)	20 (14.7)	
Post-test	Good	84 (90.3)	9 (9.7)	0.004

Variable	Category	Favorable perception n (%)	Neutral/unfavorable perception n (%)	P value
knowledge category	knowledge			
	Poor/average knowledge	67 (73.6)	24 (26.4)	

Favorable perception was defined as an overall perception score of $\geq 75\%$. P

Favorable perception was classified as having an overall perception score of $\geq 75\%$. Overall, 151 (82.1%) students had favorable perception towards gamification in learning. The favorable perception was significantly higher in Phase II students as compared to Phase III Part I students (88.0% vs 76.1%, $P = 0.034$). Students with good post-test knowledge scores had significantly high favorable perception as compared to students with poor and average post-test knowledge scores (90.3% vs 73.6%, $P = 0.004$). There was an increased proportion of favorable perception amongst students who attended two or more sessions as compared to students who attended one session; however, this correlation was statistically insignificant (85.3% vs 72.9%, $P = 0.055$) (Table 5B).

DISCUSSION

The present study assessed the effectiveness and acceptability of digital gamified learning in community medicine among undergraduate medical students. There was a significant increase in the knowledge scores after the gamified learning intervention. The mean score improved from 6.18 ± 1.83 prior to intervention to 10.94 ± 1.92 post-

values were calculated using Pearson Chi-square test

intervention, with an average increase of 4.76 marks. This suggests that digital gamified learning may be useful for immediate reinforcement of concepts taught during community medicine classes.

The percentage of students having good knowledge increased from 6.5% pre-intervention to 50.5% post-intervention. This could be attributed to active retrieval of information, instant feedback, repetition of key concepts and clarification by the faculty after each quiz item. The use of gamified quizzes ensures that the learner actively retrieves the information rather than receiving it passively, which might improve learning outcomes.^{4,6,8}

The majority of participants in this survey were in favor of gamified learning. More than 80% of students agreed or strongly agreed that gamified learning was enjoyable, enhanced focus, raised interest, boosted engagement, facilitated comprehension, and enhanced retention. The current study's findings are consistent with earlier research demonstrating that gamification enhances medical students' motivation, engagement, classroom interactions, and learning.^{5,7,8,10}

In the present study, 87.0% of students recommended using gamification in future

community medicine classes. This indicates high acceptability of gamified learning as an adjunct to conventional teaching. Community medicine includes several factual and applied topics such as epidemiology, screening, outbreak investigation, national health programmes, maternal and child health, and environmental health. These topics can be effectively revised using quiz-based digital gamification.

The online platform utilized in the study was also well accepted. Majority of the students agreed that the platform was user-friendly regarding logging in, navigating the website and submission of their responses. The high platform score in this study suggests that smartphone-based gamified learning is feasible in a routine classroom setting. Digital platforms can also help teachers obtain instant responses, identify difficult questions, and provide immediate corrective feedback.^{4,5}

Students in Phase II had a much more positive view than those in Phase III Part I. This could be because senior students are more concerned with preparing for exams, whilst junior pupils are more open to interactive learning techniques. Student preferences may differ according to academic phase, workload, assessment proximity, and learning priorities, according to a similar pattern that has been explored in educational literature.^{8,13}

Although the correlation is not statistically significant, students who attended

more than one session were linked to higher percentage of positive perceptions than students who attended only one session. This suggests that students become more accustomed to using the platform and perceive its instructional value after being exposed to digital gamified learning multiple times. Nonetheless, this finding must be interpreted carefully because the association between these variables was not statistically significant.

Students who obtained good post-test knowledge scores were statistically associated with higher favorable perception. This may indicate that students who performed better after the intervention were more likely to view gamified learning positively. However, because of the one-group study design, the direction of this relationship cannot be confirmed.

Gamified learning should not be considered a replacement for conventional teaching. Instead, it can be used as an adjunct for formative assessment, revision, and reinforcement of important concepts. Excessive competition or overemphasis on leaderboards may create anxiety among some students; therefore, gamification should be designed in a supportive and learning-oriented manner.^{8,15}

The findings support the integration of digital gamified learning into competency-based medical education, where active

learning, formative assessment, self-directed learning, and feedback are emphasized.¹³

In community medicine, gamification may be further expanded to case-based scenarios, outbreak simulations, public health decision-making exercises, and field-based problem-solving activities. Such approaches may help students apply public health concepts beyond simple factual recall.

STRENGTHS OF THE STUDY

This research employed a quantitative pretest-posttest design, where the knowledge gains and acceptability among students were tested. It was carried out in a routine classroom setup, which makes it possible to implement in other settings. The same professor facilitated the sessions throughout the duration of the intervention, which eliminates the variability of the instructor. The manuscript also reports effect size and confidence interval, improving the interpretability of the statistical findings.

LIMITATIONS OF THE STUDY

The study had certain limitations. First, the limitation of having one-group pretest-posttest design without a control group reduces the capability of inferring causation. Second, the test was taken right after the intervention; hence, the research measured only the short-term gains in knowledge and not the long-term gain. Future research should have a delayed post-test at least two weeks later to measure the educational benefit of digital gamified learning. Third, the same multiple-choice

questionnaire was used to measure the pre-test and post-test, which might have affected the outcome as a result of testing effect and recall bias. Hence, part of the improvement is likely to come from familiarizing oneself with the questions rather than the intervention itself. Fourth, the study was done at one institution only and thus may reduce the external validity. Fifth, perception responses were self-report measures and thus subject to social desirability and novelty effects. Finally, only one digital platform was assessed, and comparison with other gamified learning platforms was not performed.

CONCLUSION

Digital gamified learning helped the students improve their immediate knowledge scores. The students found it fun, engaging, motivating, and useful for enhancing attention and retention. The digital platform was also acceptable and feasible for classroom use. Gamified learning can be incorporated as an adjunct to conventional teaching in community medicine, especially for formative assessment, revision, and reinforcement of important concepts. Further controlled studies with long-term follow-up are recommended to assess its impact on knowledge retention and academic performance.

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Competing Interests - The authors declare no competing interests.

Ethical Approval - The study was approved by the Institutional Ethics Committee of Sri Venkateswara Medical College Hospital and Research Centre, Puducherry, with approval number SVMCH/IEC/2026/047 dated 04 January 2026.

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