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Behaviour Engagement Of Student's In Snakes And Ladders Game For Nutrition Education

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Abstract

This study examined the effectiveness of a specially designed a gamified Snake and Ladder nutrition game on secondary school student's engagement. For the study, a total of 80 students from JSPM School, Pusad were selected by systematic random sampling and assigned equally to an experimental group (n=40) and a control group (n=40). In the study, the experimental group received nutrition education using the snake and ladder game, were as the control group was taught through traditional lecture-based teaching. In this study student engagement was measured by the student engagement scale (SES) with 20 items, which assessed three domains. The results revealed that students who participated in the game-based learning intervention had statistically significant improvement across all three engagement domains, with the t-value significant at the 0.01 level. The behavioural engagement increased as students were attentive, took part in classroom or group activity, completed their class task regularly, and demonstrated greater effort during the lesson. The emotional engagement also shows greater enjoyment, excitement about learning, and positive attitudes toward the nutrition lessons. Cognitive engagement also showed substantial gain-students had a better understanding of concepts, remembered information more easily, and applied nutrition knowledge or concepts in everyday life. In comparison, the control group was taught through the traditional teaching method and showed only minimum statistically insignificant changes in all three domains, indicating that the tradition teaching method produced limited impact on students' attention, participation, interest, understanding, and application. The findings confirm that game-based approaches are a powerful strategy for enhancing student engagement, interest, and active participation in health education.

Keywords: Game-based learning, Nutrition education, Cognitive engagement, Behavioural engagement. Emotional engagement.

Introduction

Student engagement is a critical component of effective learning, especially in nutrition education where conceptual understanding and consistent attention are essential. The WHO state that, school-based nutrition education must not only provide information but also foster active participation, motivation, and meaningful connection with the content. Traditional lecture-based method, though widely used, often fails to stimulate active learning or sustain students' interest, particularly among adolescents. According to Nutbeam (2008) emphasized that passive approaches limit learners' capacity to internalize health information and apply it in real-life situations. In recent years, game-based learning has emerged as an innovative and entertaining way of education. Bahha and Govendar et al. (2024) Another recent study demonstrated that well-designed gamified courses can increase students' motivation, engagement, and satisfaction, especially when intrinsic and extrinsic motivational factors are properly balanced. Nairoozi et al. (2025) resulted that the board-game–style interventions have shown that modified traditional games can successfully increase nutrition knowledge, dietary awareness, and student engagement among school children and adolescents. Yuen et al. (2019) and Anderson & Rainie (2020) founded that educational games enhance cognitive engagement, increase students' participation, and improve retention concepts. Gamification makes a education more participatory and student focused, where students learn through exploration, challenge, and teamwork. The Snake and Ladder Game, a familiar and enjoyable board game, can be adapted to deliver educational content through interactive rules, reward structures, and meaningful challenges. Earlier studies have demonstrated that modified traditional games can improve knowledge regarding hygiene, diseases, and nutrition (Alkon et al., 2014). The present study examines whether integrating a Snake and Ladder–based Nutrition Game into classroom instruction enhances secondary students' interest in nutrition education. The study assesses the impact of gamified instruction with traditional teaching and evaluates whether such an approach supports higher behavioural, emotional, and cognitive engagement among adolescent learners.

Material and methods

The study was conducted on 80 school students aged 12–15 years from JSPM school, Pusad, District Yavatmal. The school was selected purposively, and the sample was chosen using systematic random sampling. Students were divided into two equal groups such as control group (n= 40) and experimental group (n=40). The experimental group was taught nutrition education using a specially designed Snake and Ladder Nutrition Game while, the control group received instruction through traditional teaching methods using a textbook and chalk bord

- **About the Snake and Ladder Nutrition Game**

The researcher developed snake and ladder game to promote engagement and understanding of nutrition concepts through an interactive gaming model.

- **Board Structure**

The board game structured as 10 by 10 grid containing 100 squares where snake used to represent unhealthy dietary behaviour while ladders symbolized healthy nutrition choice. In each square had nutrition message.

- **Game Mechanics**

In this game 3 to 4 player participated at a time and players moved on the board according to the numbers which shown on the dice if rolling a six allowed them an extra turn. In game players to climb upward by ladders when they select healthy foods and snake made them move downward when player selected poor diet option. At specific spots on the board, player required to answer nutrition question correctly to move forward.

Tool of data collection

To measure students' engagement, the Student Engagement Scale (SES) was administered after the post-intervention. The SES contained 20 items categorized into three domains: behavioural engagement to assess attention, participation, effort, and task completion; emotional engagement, which evaluates enjoyment, motivation, interest, positive and feelings; cognitive engagement, which measures reflection, curiosity, understanding, and application of learned concepts. The responses were recorded on a 5-point Likert scale ranging from 1-Strongly Disagree to 5-Strongly Agree.

Results

To assess the impact of the Snake and Ladder gamified intervention on student engagement, the mean scores and standard deviations of all 20 items were analysed, all those compared between control and experimental group using an independent samples t-test.

Table 1: Behavioural Engagement in the Experimental Group

Sr. no	Statements	Pre mean	Pre SD	Post mean	Post SD	T value
1.	Listen carefully when teacher teaches	3.10	0.81	4.25	0.72	8.42
2.	Try to answer questions in class	3.05	0.79	4.20	0.69	8.15
3.	Take part in class and group activity	3.15	0.83	4.30	0.74	8.38
4.	Complete class and home work	3.00	0.76	4.10	0.70	7.92
5.	Share my ideas during the class	3.12	0.80	4.28	0.71	8.29
6.	Pay attention when topic is difficult	3.08	0.77	4.22	0.69	8.10
7.	Try my best in class activities	3.18	0.86	4.35	0.76	8.26

These findings indicate a substantial enhancement in the behavioural engagement of students in the experimental group after being taught using the Snake and Ladder Nutrition Game. Behavioural engagement was measured through seven indicators that captured students visible participation in classroom learning, such as listening carefully when the teacher teaches, attempting to answer questions asked by the teacher, actively taking part in individual and group activities, completing classwork and homework on time, expressing ideas during the lesson, paying attention even when the topic is difficult and consistently putting forth their best effort in all class activities. The finding reported that students were able to listen more attentively during nutrition lessons, because the gamified activity generated curiosity

and excitement about what would happen next. This improvement was reflected in the mean score in the item "listen carefully when the teacher teaches", which increased from a pre-test mean score of 3.10 (SD = 0.81) to a post-test score of 4.25 (SD = 0.72). The paired t- test further confirmed that this change was statistically significant with a t value is 8.42, that indicated a substantial enhancement in attentiveness.

The competitive elements of the Snake and Ladder game motivated students to attempt more questions during the lessons, as correct answers allowed them to progress in the game. This was supported by the notable rise in the mean score of items "Try to answer questions in class", which increased from pre-test score 3.05 (SD = 0.79) to post-test mean score 4.20 (SD = 0.69) with t value of (8.15) indicating a highly meaningful improvement. The interactive structure of the gamified activity motivated students to engage more actively in classwork and group tasks. The mean score for "take part in classwork and group activities" where mean score increased from mean of 3.15 (SD = 0.83) to 4.30 (SD = 0.74), and a significant t-value of 8.38, show strong improvement. Students also indicating greater willingness to complete their classwork and homework, as they found the lessons to be more meaningful and enjoyable. This was evident in the increased in the mean score for "complete my classwork and homework", which went up from mean of 3.00 (SD = 0.76) to 4.10 (SD = 0.70), with a t value of 7.92. Furthermore, the gamified learning environment encouraged students to share their ideas more freely during class discussions. This improvement was show in the item "share my ideas during the class" where the mean score of pre-tests 3.12 (SD = 0.80) and post-test 4.28 (SD = 0.71), supported by a significant t value of 8.29. The data show that students also more attentive when topics were challenging, as the snake and ladder game structure presented complex concepts in a simplified and playful manner. This was reflected in the increase from 3.08 (SD = 0.77) to 4.22 (SD = 0.69) for the item "pay attention when the topic is difficult", supported by a significant t value of 8.10.

Students also showed a stronger tendency to put forth their best effort in all class activities after the intervention. This finding clearly shows the mean score for "try my best-in-class activities" from 3.18 (SD = 0.86) before the intervention to 4.35 (SD = 0.76) after the intervention, with a highly significant t value of 8.26. This consistent improvement across all seven items indicates increased effort, enthusiasm, and responsibility following the gamified intervention. This consistent improvement all seven behavioral items, these finding highlight a clear enhancement in students efforts level, enthusiasm for learning and responsibility as a result of the gamified instructional approach.

Table 2: Behavioural Engagement in the control Group

Sr. No	Statements	Pre mean	Pre SD	Post mean	Post SD	T Value
1.	Listen carefully when teacher teaches	3.05	0.77	3.18	0.74	1.92
2.	Try to answer questions in class	3.12	0.80	3.25	0.78	1.88
3.	Take part in class and group activity	3.08	0.79	3.20	0.75	1.75
4.	Complete class and home work	3.00	0.76	3.15	0.72	1.98
5.	Share my ideas during the class	3.10	0.82	3.22	0.78	1.70
6.	Pay attention when topic is difficult	3.05	0.80	3.18	0.76	1.82
7.	Try my best-in-class activities	3.15	0.81	3.28	0.79	1.69

Compared to the experimental group, the control group showed minimum improvement in behavioural engagement following the traditional teaching method. The post-test mean scores for all seven behavioural items were only slightly higher than their corresponding pre-test means and the differences were statistically insignificant ($p > .05$). This indicates that the lecture-based approach did not meaningfully enhance students' behavioural participation or involvement. For the item "Listen carefully when the teacher teaches", the mean score increased marginally from 3.05 (SD = 0.77) in the pretest to 3.18 (SD = 0.74) in the post-test and the corresponding t value of 1.92 indicated that this difference was statistically nonsignificant. Similarly, the item "Try to answer questions in class" showed a small change from mean 3.12 (SD = 0.80) to mean 3.25 (SD = 0.78), with a t value of 1.88, indicating no meaningful progress.

The statement "Take part in class and group activity" recorded an average change in mean from 3.08 (SD = 0.79) in the pre-test to 3.20 (SD = 0.75) in the post-test, with a t-value of 1.75. Similarly, the item "Complete class and homework" increased slightly from 3.00 (SD = 0.76) to 3.15 (SD = 0.72), with t value of 1.98, which also remained statistically nonsignificant. In the same way, the behavior "Share my ideas during the class" increased the mean score from 3.10 (SD = 0.82) to 3.22 (SD = 0.78), showing a t-value of 1.70, and "Pay attention when the topic is difficult" increased the mean score from 3.05 (SD = 0.80) to 3.18 (SD = 0.76), with a t-value of 1.82; all of these indicated non-significant changes. Lastly, for the item "Try my best-in-class activities," increased the mean score from 3.15 (SD = 0.81) in the pre-test to 3.28 (SD = 0.79) in the post-test, with a t-value of 1.69, again showing no meaningful improvement in this aspect of behavior engagement.

Table 3: Emotional Engagement in the Experimental Group

Sr. no	Statements	Pre mean	Pre SD	Post mean	Post SD	T Value
1.	Enjoy learning nutrition.	3.20	0.84	4.40	0.75	8.62
2.	Feel excited during nutrition games	3.10	0.81	4.32	0.72	8.55
3.	Happy learning new healthy eating facts	3.05	0.79	4.25	0.74	8.48
4.	Look forward to nutrition class	3.15	0.82	4.38	0.78	8.76
5.	Like learning with classmates	3.00	0.75	4.15	0.70	8.05
6.	Feel proud answering correctly	3.18	0.84	4.36	0.76	8.42
7.	I feel nutrition is important for me	3.22	0.86	4.40	0.78	8.39

The findings indicated a substantial enhancement in the emotional engagement of students in the experimental group after the gamified intervention in the Snake and Ladder Nutrition Game, students reported higher levels of enjoyment, excitement, and emotional connection to the nutrition concepts. The competitive and playful features of the game such as climbing ladders for correct answers and descending snakes for incorrect ones stimulated learners' curiosity, anticipation, and motivation among the learners. A detailed review of the emotional engagement items showed significantly higher enjoyment of nutrition lessons, with mean scores rising from 3.20 (SD= 0.84) to 4.40 (SD=0.75) and t value 8.62. Students also displayed higher levels of excitement during nutrition games, with improving mean value score from 3.10 in pre-test with SD=0.81 to 4.32 post-test with SD = 0.72 and (t = 8.55). Similarly, students reported feeling happier when learning new facts about healthy eating, reflected in a rise from 3.05 ± 0.79 to 4.25 ± 0.74 (t = 8.48). This pattern was also observed in another remaining pattern . The mean score of Looking forward to nutrition class increased from 3.15 (SD = 0.82) to 4.38 (SD = 0.78) with t-value, The enjoyment of learning with classmates also rose from 3.00 (SD = 0.75) to 4.15 (SD = 0.70) (t = 8.05), while students also reported feeling proud when answering correctly, rising from 3.18 (SD = 0.84) to 4.36 (SD = 0.76) (t = 8.42). Finally, students' perceptions that nutrition is very important increased significantly, from 3.22 (SD = 0.86) to 4.40 (SD = 0.78) (t = 8.39). Overall, the result of the paired t-test show that all improvements were statistically significant at $p < .001$, confirming that the gamified approach had generated positive emotion, interest in subject and strengthened students emotional involvement in the learning process.

Table 4: Emotional Engagement in the Control Group

Sr. no	Statements	Pre mean	Pre SD	Post mean	Post SD	T Value
1.	Enjoy learning nutrition.	3.05	0.77	3.18	0.74	1.92
2.	Feel excited during nutrition games	3.12	0.80	3.25	0.78	1.88
3.	Happy learning new healthy eating facts	3.08	0.79	3.20	0.75	1.75
4.	Look forward to nutrition class	3.00	0.76	3.15	0.72	1.98
5.	Like learning with classmates	3.10	0.82	3.22	0.78	1.70
6.	Feel proud answering correctly	3.05	0.80	3.18	0.76	1.82
7.	Feel nutrition is important for me	3.15	0.81	3.28	0.79	1.69

In the control group study emotional engagement exhibited only minimum changes from pre-test to post-test, as indicated by the statistical analysis of all seven emotional engagement statements. For example, the item "I enjoy learning nutrition," the pre-test mean was 3.05 (SD = 0.77), which increased marginally to 3.18 (SD = 0.74) in the post-test, resulting in a non-significant t value of 1.92. Similarly, students' excitement toward nutrition lessons, measured by the statement "excitement during nutrition classes," resulted in a small rise from a pre-test mean value of 3.12 (SD = 0.80) to a post-test mean value of 3.25 (SD = 0.78), with a t-value of 1.88, again demonstrating no statistically meaningful improvement. The finding of emotional response to learning new information also remained low in change. For the statement "happy learning new healthy eating facts," the pre-test mean of 3.08 (SD = 0.79) increased slightly to 3.20 (SD = 0.75) with a t value of 1.75. A similar trend was observed in students' anticipation of nutrition classes where the mean score increased from 3.00 (SD = 0.76) to 3.15 (SD = 0.72) with a t-value of 1.98, which is

nonsignificant. In the same way interactions with classmates showed only a slightly increase in the statement "like learning with my classmates," a pre-test mean of 3.10 (SD = 0.82) and a post-test mean of 3.22 (SD = 0.78), reflecting in a non-significant t-value of 1.70. Likewise, students' feelings of pride when answering questions correctly showed minimum improvement from 3.05 (SD = 0.80) to 3.18 (SD = 0.76) with non-significant t-value of 1.82. Finally, the perceived importance of nutrition showed the smallest change, as the mean from 3.15 (SD = 0.81) to 3.28 (SD = 0.79), resulting a t value of 1.69.

Overall, the result indicated that although slightly increases occurred across all seven emotional engagement items, none reached statistical significance ($p > .05$) This suggests that the traditional lecture-based method appears insufficient in enhancing students' emotional engagement with the subject. Students may have perceived the lessons as routine, repetitive, or uninteresting, leading to limited emotional connection and reducing their level of enthusiasm for learning.

Table 5: Cognitive Engagement in the experimental group

Sr. No	Statements	Pre Mean	Pre SD	Post mean	Post SD	T Value
1.	Understand why healthy food matter	3.10	0.80	4.30	0.73	8.68
2.	Think about lesson after classes	3.12	0.81	4.32	0.74	8.56
3.	Use nutrition knowledge in my daily life	3.18	0.85	4.38	0.79	8.44
4.	Try to remember nutrition chapter	3.08	0.78	4.25	0.71	8.22
5.	Search more healthy food information	3.20	0.84	4.40	0.76	8.66
6.	Work hard to understand difficult topic	3.15	0.82	4.32	0.75	8.51

Analysis of the experimental group showed a substantial and statistically significant improvement in students' cognitive engagement after the gamified intervention. In this context, cognitive engagement represents the level of mental effort students make in understanding, processing, and applying information. In this study, measured six specific aspects of cognitive engagement understanding the importance of healthy food, applying nutrition knowledge in daily life, thinking about lessons after class, remembering nutrition content, searching for additional or further information and working hard to understand challenging content. These findings proved that each of these areas improved considerably after students engaged with the Snake and Ladder Nutrition Game. The first cognitive item measured students understood of why healthy food is important. The pre-test mean score for this statement was 3.10 (SD = 0.80), reflecting a moderate level of initial understanding. After the intervention, the post-test mean increased substantially to 4.30 (SD = 0.73). The paired samples t-test produced a highly significant value of $t = 8.68$ ($p < .001$), indicating that the game-based learning method significantly enhanced students understanding of nutrition concepts.

Another second cognitive aspect measured whether students continued thinking about the nutrition chapter even after class. The pre-test mean was 3.12 (SD = 0.81) and increased to 4.32 (SD = 0.74) in the post-test. This significant improvement, confirmed by a t-value of 8.56 ($p < .001$), indicates that the gamified learning approach successfully encouraged students to reflect on nutrition concepts even after the lesson had ended. The third aspect examined how effectively students used their nutrition knowledge in daily lives. Before the intervention, students showed a moderate level of application, with pretest mean of

3.18 (SD = 0.85). After participating in the gamified approach, this increased to 4.38 (SD = 0.79). The statistically significant t-value of 8.44 ($p < .001$) indicates that the Snake and Ladder game successfully encouraged students to adopt healthier dietary habits in their daily routines. The fourth aspect measured students' effort to remember the nutrition chapter. The pre-test mean score of 3.08 (SD = 0.78) increased to 4.25 (SD = 0.71) in the post-test, with a highly significant t-value of 8.22 ($p < .001$). This indicated that the gamified teaching method enhanced memory retention. The repeated engagement with nutrition concepts through the game's question and answer activities helped reinforce the learning and strengthened recall.

The fifth cognitive engagement item addressed the degree to which students searched for additional information about healthy food and nutrition. Prior to the intervention, the mean score for this item was 3.20 (SD = 0.84), which increased to 4.40 (SD = 0.76) afterward. With a significant t-value of 8.66 ($p < .001$), this improvement suggests that the game sparked curiosity and motivated students to explore nutrition related topics, demonstrating increased self-directed learning. The final cognitive aspect examined students' persistence when faced with challenging nutrition concepts. The pre-test mean score was 3.15 (SD = 0.82), while the post-test mean increased to 4.32 (SD = 0.75). The paired t-test has a highly significant value of $t = 8.51$ ($p < .001$). The result indicates that the game-based approach. These finding suggest that game-based method encouraged students to work harder, tackle complex material with confidence and engaged more deeply when content become challenging. Collectively, these findings demonstrate a consistent pattern: all six cognitive items recorded significant improvements, each supported by a strong t-value and a considerable increase in mean scores. The interactive and playful nature of the Snake and Ladder Nutrition Game likely played a central role in promoting these cognitive gains. The game required students to think critically, recall information, and apply what they learned during every move, making the learning process more mentally stimulating. This continuous engagement with the content reinforced deeper processing, improved comprehension, and enhanced the ability to transfer knowledge to real-life situations.

Overall, these findings indicate that all six cognitive statements improved significantly, as reflected in both the strong t-values and a considerable increase in mean scores. These outcomes suggest that the Snake and Ladder Nutrition Game played a central role in boosting students' cognitive engagement like thinking, remembering and applying nutrition concepts, turning learning into an active mental process. Such continuous and meaningful engagement with the content allowed students to process information more deeply, improved their comprehension and enhanced the ability to transfer knowledge in to real life situation.

Table 6: Cognitive Engagement in the control group

Sr. No	Statements	Pre Mean	Pre SD	Post mean	Post SD	T Value
1.	Understand why healthy food matter	3.08	0.81	3.20	0.79	1.72
2.	Think about lesson after classes	3.15	0.82	3.28	0.78	1.64
3.	Use nutrition knowledge in my daily life	3.10	0.79	3.25	0.77	1.94
4.	Try to remember nutrition chapter	3.12	0.80	3.25	0.78	1.77
5.	Search more healthy food information	3.05	0.78	3.18	0.75	1.86
6.	Work hard to understand difficult topic	3.08	0.82	3.22	0.80	1.72

The control group exhibited the statement-understand why healthy food matters, with a pre-test mean score of 3.08 (SD = 0.81) that increased only to 3.20 (SD = 0.79) in the post test, with a t-value of 1.72, indicating no significant changes. Similarly, the statement "think about lessons after class" reflected a pretest mean score of 3.15 (SD = 0.82) which increased marginally to 3.28 (SD = 0.78), with a t-value of 1.64, again showing no meaningful improvement. Similarly, the application of nutrition knowledge also showed limited progress for the statement " use nutrition knowledge in my daily life," the mean increased slightly from 3.10 (SD = 0.79) pre-test mean score to 3.25 (SD = 0.77) post-test mean score and the t-value of 1.94 indicated that this change was statistically insignificant. Also, the statement "try to remember nutrition lessons" showed a minor increase from 3.12 (SD = 0.80) to 3.25 (SD = 0.78), with a t-value of 1.77, confirming that no substantial improvement occurred. Likewise, the mean score for the statement "search for more healthy food information" increased slightly from 3.05 (SD = 0.78) to 3.18 (SD = 0.75) with a t-value of 1.86, which remained not statistically significant. Finally, the statement "Work hard to understand difficult topics" also showed a small increase from 3.08 (SD = 0.82) pretest score to 3.22 (SD = 0.80) post test score, with a t-value of 1.72, again indicating an insignificant difference. Across the six cognitive items, the minimum improvements suggest that the lecture-based methods did not show any significant gains in students understanding, retention or recall or application of nutrition knowledge. Students showed minimum change in mental effort, reflection, motivation to search for additional information and persistence with difficult topics. Overall, their cognitive engagement remained nearly unchanged over the duration of the study.

Discussion

The purpose of this study to evaluate the impact of gamification, through the Snake and Ladder Nutrition Game, on secondary school students' engagement in nutrition education. Engagement was assessed in three domains- behavioural, emotional and cognitive using the Student Engagement Scale (SES). Results from pre-test and post-test data revealed that the gamified intervention approach produced significant improvements in all three domains in the experimental group while the control group recorded only slight and non-significant changes. The result suggest that gamification is an effective pedagogical strategy for enhancing students' engagement. Students who participated in the game-based learning became more active, focused and willing to participate in classroom discussion or task. The previous research study indicates that game-based learning strategies increase concentration, enthusiasm and participation by integrating enjoyable and interactive elements into teaching.

Emotional engagement improved significantly in the experimental group. Students expressed greater levels of enjoyment and enthusiasm during nutrition lessons, which resulted in positive emotional responses and greater eagerness toward learning. In contrast traditional lecture-based instruction did not produce the same emotional responses. Students in the control group showed only slightly changes in enjoyment and motivation. These results are consistent with previous studies that identify enjoyment and positive emotions are very important element in learning, particularly when lessons involve instructional method and game base activities. Additionally, cognitive engagement improved substantially in the experimental group students. The students who participated in gamified learning not only understood nutrition concepts more deeply but also remembered them and applied nutrition concepts in daily life. They showed stronger effort in solving challenges, recalling information, making connections to real-world situations, and working through difficult topics. This demonstrates that gamification can support higher-order thinking, reflection, and knowledge retention. In contrast, students in the control group showed minimal cognitive improvement, suggesting that traditional teaching approaches may not be sufficient to stimulate critical thinking or independent learning.

Conclusion

The study concludes that gamification through the snake and ladder nutrition game significantly increased student engagement in nutrition education. The experimental group students improved in behavioural, emotional and cognitive engagement while the control group exhibited minimum changes across all domains. These results demonstrate that the gamified teaching methods is more effective than the traditional teaching method which increase active participation, enjoyment, and deeper learning. Therefore, this study recommended gamification as a very effective, interesting, and low-cost strategy for nutrition education and other academic areas.

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