



## **Factors Influencing the Learning of Class XII Science: A Perspectives of Students**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/JESBS/2021/v34i1030363

*Editor(s):*

(1) Dr. Shao-I Chiu, Da-Yeh University, Taiwan.

*Reviewers:*

(1) Thomas McCloughlin, Dublin City University, Ireland.

(2) Reji D. Nair, Higher Colleges of Technology, UAE.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/75184>

**Original Research Article**

**Received 29 July 2021**

**Accepted 05 October 2021**

**Published 08 October 2021**

### **ABSTRACT**

The purpose of this study is to investigate the factors influencing students' higher secondary level science performance in one of the higher secondary schools of Bhutan. A total of 150 students were selected through purposive sampling. The sample includes both current classes XI and XII and former class XII graduates of the school. Through the use of mixed method research design, the data were collected using survey questionnaires and interview in focus group. The quantitative data were analysed using descriptive statistics techniques and qualitative based on themes. The result of the study showed that the science performance of students were negatively affected by the inadequate support from school administration, lack of experienced and dedicated teachers and, poor supports from parents and relatives of the students. Thus, this study recommends school administration to take extra initiative towards improving students' academic performance and teachers to explore different teaching pedagogies that can stimulate students' interest towards learning science.

*Keywords: Science; influence; affecting; performance; investigate.*

## 1. INTRODUCTION

The development of science and technology is recognized worldwide as one of the fundamental tool for a nation's overall economic development [1]. An effective use of science and technology is able to increase the productivity to meet the needs of changing society. According to United Nations [2] there has been demonstrated in the developed countries, and more recently in the developing and least developed countries, where science and technology have been responsible for solving real world problems such as combating climate change, poverty reduction and overcoming waste management problems. Science education, therefore should be appealing to all the learners, regardless of societal background, culture, and colour. Students are likely to learn better when they are interested in the subject, hence it becomes important to know the factors affecting students' interest in learning of school science [3].

The application of science and technology are extremely important in our daily life because they made our life easy, comfortable and secure on the one hand, while environmental issues have been exacerbated on the other. In addition, science and technology have made a remarkable contribution in the field of education for decades [4]. Therefore, it is important to ensure that learners get the best science education through a diverse and holistic curriculum. The author considers teachers as the curriculum drivers, and so they should be competent and professionally dedicated to implement the holistic curriculum within the four walls of classroom. Besides curriculum and teachers, school leaders also plays as dynamic role in providing best science education through creation of conducive and learning environment for both teachers and students. They are also responsible in supporting and guiding teachers in enhancing both pedagogical and content knowledge.

Despite growing importance of science and technology in all spheres of life in any society, there is a big concern over students' poor performance in science [5]. This is not an exception in the proposed school of this study. The number of students taking science stream after class X is gradually decreasing over the years and the same trend being is repeated with the performance of students in science. Although it seems that various issues are related students poor performance in science, studies indicates that the learning environment in the school plays

a significant role. For example, Chang & Park [6] suggested that effectiveness of teaching is critical factor for that has great impact on students' performance. Similarly, Tatar, Tüysüz, Tosun & İlha [7] pointed that the most important factor of science achievement is teachers and the curriculum.

The first batch of Class XII students of the selected school for this study appeared ISC exam (Indian School Council (ISC) Examination) in 2003 (n= 28 science students. Up till now (2020) during the time of this study, 17 batches of students had appeared class XII science examination since 2003. However, this study has considered the performance of last cohorts. Therefore this study do not intend to analyze the science results before 2014. According to the reports prepared by Bhutan Council for School Examinations and Assessment [8]; [9]; [10]; [11]; [12]; [13], science students of the school did not perform well in science subjects. The detail of report is given in the Table 1.

**Table 1. Comparison between national mean and the mean mark of the selected school (BCSEA)**

Year	School Mean Mark(A)	National Mean Mark (B)	Difference (A-B)
2013	53	53	0
2014	48	56	-8
2016	49	55	-6
2017	50	59	-9
2018	51	62	-11
2019	59	66	-7

The Table 1 indicates that there is significant differences over the years between the national science mean mark and science mean mark of school. Only in 2013 did, the science mean marks of the school has equal the national mean mark. However, in 2014 the science mean mark of school is significantly lower than national science mean mark with difference of -8. Similarly the same trend is repeated in the following year. The table also shows that from 2017 the difference in mean mark has further increased. The latest 2019 mean marks also indicates that the average score of school under this study students is not at par with the national mean mark and the data for 2020 examination was not available during the time of this study due to delay of Bhutan Higher Secondary Certificate Examination amidst COVID-19 pandemic.

Over the years, teachers of the school under this study has been observing that most of the students who qualified from class X prefer not to continue their study in the same school. Most of the students with high science marks opt to join other higher secondary schools across the kingdom. Therefore, there are not many students who opt to take science stream. This is evident from the total number students currently studying in science classes of XI and XII. At present there are only 17 students in class XII and 19 students in XI. According to Kinyota [14] students' choice of science stream is influenced by the factors such as students' examination scores, self-efficacy in science, knowledge of available careers, gender and school resource contexts. Therefore, this study is proposed to find out the factors affecting the learning of class XII science in one of the higher secondary schools in western Bhutan.

## 2. LITERATURE REVIEW

Science is considered as one of the difficult subject among Bhutanese students. This is evident from the recent PISA assessment. For the first time in the history of Bhutanese education system, Bhutan participated in PISA-D assessment along with 7 least developed countries in the year 2018. According to the PISA analysis report compiled by Bhutan Council for School Examination and Assessment [13] the performance of Bhutanese students is significantly low compared to PISA leading countries like Singapore, Finland and Japan. However, Bhutan was ranked 2<sup>nd</sup> in PISA-D among eight least developed countries. There are numerous studies carried out to investigate the factors affecting the performance of students in science in international context. On contrary, there are limited studies conducted in Bhutanese education context. Therefore, it is an opportunity for the researchers to carry out this study in context to Bhutanese education system.

### 2.1 Factors Influencing the Learning of Science in Global Context

Sunday, Sunday, Owadara, Nwosu, Et al. [16] conducted a study to investigate the factors affecting academic achievement of physics education in two Nigerian Universities. The study was carried out using sample size of 108 students from two universities. The study identified the different factors that are affecting students' performance in physics such as; lack of interest in teaching by teacher, inadequate

support from parents, poor study habits among students and lack of laboratory and library facilities in the colleges. Similarly, Alachi [17] pointed out that parent's financial abilities and nature of home discipline significantly affects students' academic performance. However, Farooq, Chaudhry, Shafiq & Berhanu, Et al. [18] expressed that parents' economic background and education have significant effect on students' academic performance.

According to Kalagbor [19] some of the factors that influences students' performance in private and public schools of Rivers State of Nigeria are; teacher student relationship, home background of the child, teachers content knowledge and skills, teacher student ratio and students' level of discipline. A total of 631 students from both public and private schools were included for the study.

However, a recent study by Njiru and Karuku [20] concluded that there are three major factors that influence the students' performance in science. The three major factors are; learning factors, teaching factors and administrative factors. Learning factors includes such as students 'study habits, time management and interest towards science. Teaching factors are those factors which are associated with teachers such as; quality of teacher, student-teacher interactions and teachers' teaching skills and knowledge. Meanwhile, administrative factors include access to resources and quality of guidance.

In the same way, King'aru [21] conducted a study on the factors contributing to poor performance of science subject. The research was carried out in secondary schools in Kawe Division, Kinondoni Municipality, Tanzania. A sample of 98 students from five secondary schools were involved in the study. The main findings of this study showed that the availability of teaching and learning resources, students' negative attitude towards science and curriculum gap are the factors contributing to the poor performance in science. Most of the studies conducted across the world revealed common factors that influences the performance of students' in science subjects are; parents economic background, inadequate teaching and learning resources in the school, teachers quality, administrative lapses, students' negative attitude towards physics and poor study habits among the students.

## 2.2 Factors Affecting Learning of Science in Bhutanese Context

Godon [22] aimed to identify pertaining issues and challenges being faced by teachers and the schools in Bhutan. It was highlighted that the inadequate supply of infrastructures in the schools, poor classroom setting, inaccessible indoor spaces and lack of proper toilet facilities for students were some of the issues that required urgent attention from the agencies concerned. In line with these findings, it is also understood that students draw the best from the school when they receive good physical and mental care. However, to promote the physical wellbeing of the students, schools and government should be in position to provide the best infrastructures and other facilities required by the students. In addition, Chogyel and Wangdi [23] argue that the factors such as non-availability of laboratory resources, teachers-heavy workload, large class size and inadequate time allocated to teaching science exert remarkable influence on teaching of science in middle and higher secondary schools.

As per Zangmo [24] students' attitude towards learning of science is greatly influenced by the parents' involvement. She highlighted that the children of those parents who frequently get involved with the students in science activities are likely to choose science stream after completion of class X. In Bhutanese education system, the learning of formal science starts from class IV. Till class VI science is taught as general science. For classes VII and VIII, three separate sciences are prescribed in one textbook and taught as a single subject. However, from class IX, three disciplines of science is offered as separated subjects as: physics, chemistry and biology as compulsory subject. After completion of class X, science subject is offered as separate stream besides Commerce and Arts.

Tenzin, Tshering, Wangdi and Choden [25] pointed out that parents' encouragements, career choices, past achievement, teaching strategies and student teacher relationship are the most important factors which determines students' interest and foster them to develop positive attitude towards learning science. The study also highlighted that classroom environment, parental background and location of school were also some of the factors that affects the learning of science.

Although there are many factors that impact the learning of higher secondary science in Bhutan as discussed above, the overall national performance of higher secondary science in 2019 examination was rated best in the last 14 years. Dema [26] reported that the Bhutan Higher Secondary Education Certificate (BHSEC) 2019 Examination recorded the highest pass percentage, 91.55 percent, in the last 14 years. This is an increase of 3.56 percent from 87.99 percent recorded in 2018. Moreover, science students topped the class XII board examination 2019 result with 96.29 percent candidates passing the examination. The pass percentage is 93.39 percent in Arts and 85.78 percent in commerce. However, students of the school under this study did not perform at par with rest of the students of the country. As a result, this study may help to identify the factors influencing the learning of higher secondary science in Bhutanese schools.

## 3. METHODS

This study employed mixed method to find out the factors affecting the learning of class XII science in one of the higher secondary schools of Bhutan. Bryman [27] carried out a content analysis of 232 social science journal articles and disclosed that majority of the articles has used mixed method combining survey and interviews. Similarly, Doyle, Brady and Byrne [28] identified several benefits of using mixed methods such as triangulation of data, offsetting weaknesses and providing stronger interference. Further, Creswell, Fetters, and Ivankova [29] claim that data triangulation design is one of the most prominent designs used by the researchers. The approach has been used as a means of triangulation in order for quantitative and qualitative data to help validate each other. This is supported by Dang [30] who states that mixed method has two significant benefits. First, it provides cross validations by triangulations and second, it gains complementary results by using the strength of one method to improve the other method.

### 3.1 Informants and Sampling

A total of 150 students of current class XII science and two former science batches of School under this study were selected through purposive sampling. The current science students includes 25 each from class XI and XII Science, 2020 and the remaining 100 were science graduates of 2019 and 2018. The same group of students were made to participate for an

interview. However, only class 12 of them consisting of equal number of boys and girls were included for interview.

### 3.2 Data Collection Tools

Rowley [30] states that the main advantage of survey questionnaires is the ability to collect information from large number of people from scattered places and possibly from remote locations. Although questionnaires are mostly used as a quantitative data collection tools, it can be also used to collect qualitative oriented research questions. For obtaining qualitative data, interview was conducted using semi structured questions in focus group. Since this study was intended to find out the factors affecting the learning of class XII science, survey questionnaires and interview was found to be the most appropriate data generating tools. The qualitative data was analyzed based on themes and quantitative based on descriptive statistics. For further interpretation of statistics, mean and standard deviation was used.

## 4. RESULT ANALYSIS

This study investigates the factors influencing the performance of the higher secondary science in one of the higher secondary schools in Bhutan. The descriptive data which was obtained from survey questionnaire was interpreted in terms of mean and standard deviation. Using SPSS, the mean of Likert scale rating was categorized into three level as; 1 – 2.4(low), 2.4 – 3.8 (moderate) and 3.8 – 5 (high). In order to triangulate the data, the interview data was analyzed based on themes.

### 4.1 Resources and Administrative Factor

The average mean of the Table 2 is  $M = 2.7$  which falls in moderate level category indicates that somehow school administration failed to provide necessary support and guidance to enhance students' learning. However, the statement "*School administration supports and encourages effective learning*" which received the highest mean of 2.94 shows that school administration still promotes and support effective learning. The rating of the statement "*school provides opportunity for extra study time after school or after usual study hours*" which is lowest in the table confirms that school does not provide extra study hours for students beyond school normal time.

Although, students agree to the adequate number of science teachers and laboratories in the school, some of the students expressed that lab equipment need to be replaced with latest one as the old and rusted apparatus hampers in getting accurate result during the practical lesson. Majority of the students also acknowledge the support and guidance received from the students, however, they expressed few concerns regarding daily teaching timetable and internet facilities of the school. Students feel they can surge their performances if given extra attention, remedial classes, and requested for extra hour light at hostel so that they can study. Some of the students feel the need for science exhibitions to be held in school to enhance students' academic performances drastically.

Another issue being expressed by students is insufficient of two block period (45 minutes each) for carrying practical work in the laboratory. Students expressed the need of extra time after school for carrying out practical. Similarly, students also feel that separate study room for science students is necessary so as to avoid disturbances from rest of the students. Students argue that the separate study room for students will strengthen the collaborative learning among the science students. Students also shared the need for the access to the internet during weekend and continuous light for extra hours after study. Similarly, students also suggest that science subjects to be taught by the full time teachers who were not involved with the administrative role and responsibilities, so that teachers' classroom timing doesn't get interfere by the administrative works.

### 4.2 Teaching and Learning Factor

Table 3 shows students rating for teaching and learning factor. The mean rating 3.42 and  $SD = 1.016$ , this indicates that students were satisfied with teaching carried out by science teachers and their learning is progressive. The statement "my science teacher is confident in teaching science subject" received the highest mean and lowest standard deviation which indicates that teachers' abilities to deliver the lesson is up to the expectation of the students. Moreover, the interview data concur quantitative data. The data revealed that 77.1% of the students believe that science teachers use all the allocated time for teaching using different teaching methods. Similarly, students also agree that science teachers make lesson interactive by using variety of questioning technique to teach students and conducts class test to evaluate their learning.

However, 42.9% of the students argue that teacher should use prior knowledge before the start of new chapter and teachers hardly use test results to give extra help to learners. For instance, a student suggest that subject teacher can take a greater role by asking question to students and give them imposition if students are unable to answer the questions. Another student said;

*"I normally face challenges when teachers rush to complete a chapter in three periods and assign few more chapters to learn by ourselves. Moreover, equipment in our lab being so old, we face difficulty in getting accurate readings. (R13)"*

Some students pointed out that some of the science teachers lack confidence in delivering the lesson especially the inexperienced and the new teachers. For example, S19 described that "We need a capable and a teacher who can help student understand the conceptual knowledge to relate with the reality. They believed that the barrier to learning can be minimized by practicing discussion in the class, showing video tutorials, oral test and by solving numerical in the class by the teachers. Students also expressed that some of the teachers just rush to cover the syllabus and complete a chapter in single period. In addition, students complain that some of the teachers were providing more guidance and support to high achievers and least bothered about the low performers. Teachers also need to update their teaching strategies and collect timely feedback from students to improve their teaching strategies and managing the classes. Some other issues raised by the students are teachers' punctuality, ability to relate classroom teaching in real life-application and being a good classroom teacher.

### **4.3 Students Attitude and Beliefs towards Learning of Science**

The rating of Table 4 indicates that students have positive belief and attitude towards science and inclusively agree that science subjects are related to everyday life and important in life. This can be understood from the mean rating  $M = 3.6$  which falls in high level category. In addition, students view that availability of learning resources is vital for effective learning outcome. Practical work carried out for conceptual learning helps students learning and strict discipline during lesson contributes to better results. Students are positive about learning science

subject, 91.4% of the students strongly believe that they are motivate in learning science. 97.1% students said science lesson is interesting. Classroom learning is approachable because 74.3% students can ask doubt in the class. In addition, 37.1% students are not able to complete homework given during classroom teaching. It was also noted that only 40% of the student agreed that school provide incentives for students performing better in different science subjects.

Learners are responsible for their own learning under the guidance of facilitators, the zeal and the motivation for learning should come from students themselves. S6 shared that "the factor affecting my performance is lack of time management and feeling overburdened by the subject". Similarly, S8 believed that it is difficult to keep interest in the subject. However, others feel that teacher and school administration should give much time and attention. However, S16 responded that "Science subject can be scored higher only if we put our best. Teacher they gave their best but the students fails themselves to focus on learning. Students also suggest that teachers can stimulate students' interest by designing interactive lesson through use of videos and other digital resources.

It was found that the students receive minimum support and guidance from parents, either because their parents are illiterate or their relatives are from different educational background. Few students depend on multimedia such as Google Search and YouTube, whereas others simply depend on classroom learning. However, R16 asserted that "It all depends upon the family, some parents are uneducated, and so it would be difficult to get assistance from them. R18 has a different view, "When asked with CBQ it's very difficult for me to answer. At home no one assist me". Generally, students learn own their own and CBQ is difficult aspect in learning science subject and parents or relatives can hardly guide them. Students agree that good relationship within peers and classmates can help them enhance their learning. The co-operative discussion in absence of subject teacher helps them in learning, students prefer to communicate, ask doubts within their desk mates and learn. R5 responded saying that ,

*"The relationship with my classmates has direct impact on my learning as we interact with each other and clear doubts among us. Sometimes we feel uncomfortable with teachers".*

**Table 2. Students rating on resource and administrative factor**

Sl. No	Statements	Mean	SD	level
1	The head of science department gives the necessary support	2.86	1.06	Moderate
2	School administration supports and encourages effective learning	2.94	1.19	Moderate
3	I am satisfied with rules and regulation on study timing set by Administration	2.94	1.26	Moderate
4	I feel my school administration focuses on school performances	2.51	1.29	Moderate
5	Does your school admin provide you with safe and learning environment after school?	2.57	.98	Low
6	School provides opportunity for extra study time after school or after usual study hours	2.40	1.48	Low
<b>Average mean rating</b>		2.7	0.99	

**Table 3. Students' rating for Teaching and Learning factor**

Sl. No	Statements	Mean	SD	Level
1	My science teacher is confident in teaching subject	3.94	0.838	High
2	I easily understand, what my teacher teaches in the class	3.31	0.867	Moderate
3	I believe learning science is based on how clearly teacher explains in the class	3.51	1.222	High
4.	Science teacher uses different learning AIDS when presenting lessons	3.77	1.06	High
5	teachers are confident on conceptual understanding of the science subjects	3.86	0.912	High
6	Students experience comfortable learning environment	2.97	1.098	Moderate
7	Science teacher assess learners frequently	3.4	1.035	Moderate
8	I receive constructive feedback from my science teacher	2.83	1.071	Moderate
9	Your science teacher captures the attention of learners throughout the lesson	3.03	1.272	Moderate
10	Science teacher identify learners with problems and assist them individually	3.51	0.919	High
<b>Average mean rating</b>		3.42	1.016	

**Table 4. Rating on attitude and beliefs towards science**

Sl. No	Statements	Mean	SD	Level
1	Science is a subject related to everyday life	4.77	0.49	Highest
2	Science is important in life	4.74	0.443	Highest
3	Science is a manageable subject	3.6	1.193	High
4	Practical work helps me to understand science better	4.03	0.954	High
5	Discipline during lessons results in good marks	3.66	1.11	High
6	Parental involvement in my school work motivates me	4.17	0.891	High
7	Changes in curriculum affect my learning	3.57	1.243	High
8	My home environment contributes towards my school performance	4	1.085	High
<b>Average Mean Rating</b>		3.6	0.9	

## 5. DISCUSSION

This research emphasizes on identifying the factors that are influencing the students' performance in science and the analysis of the result revealed three main factors as discussed below. School administration plays a significant role in providing quality education to the students, therefore, it must strive to create a community of learners who are physically and mentally healthy, efficient and responsive and

whose behaviors are acceptable to the society [31]. Similarly, school resources are no doubt important in the designing of a conducive teaching-learning environment. The use of these resources could give more valuable and powerful direction to the teacher than any personal efforts without the materials. On contrary, the findings of this study suggested that students do not receive required support from the school administration. However, students agree to the availability of infrastructures such as science laboratories and

human resources. In the light of the results of literature review, this finding of this study is inconsistent with Badarna and Ashour, [32] who stated that role of school administration is fairly moderate in providing academic support and motivations. Students were also in view of old and rusted science equipment which directly hampers the accuracy of experimental results.

Students' performance is directly influenced by the quality of the teachers as they are the facilitators and the designers of the learning outcome. The achievements of the students depend on how well the teacher is creative in terms of designing interactive lesson that could touch the learners interest and connect with the real-life situations. In this current study, on average, students contended with the performance of the subject teachers, however, few of them still felt that some teachers lacked confidence in delivering the lesson. Findings of this study concur with Kalagbor [19] who stated that quality of teachers can have adverse impact on students' performance and a creative and motivated teachers are likely to influence students' performance positively and vice-versa. Some of the students mention that science teachers should devote their full time and energy in classroom teaching rather than administrative works, just because of administrative works, the regular teaching classes get frequently disturbed. In addition, findings of this study also suggest that students prefer experienced subject teachers compared to new and inexperienced teachers. Relatively- new teachers were not able to meet the expectations of the students as they were found little incompetent in delivering and managing the classes.

With regard to students' attitude and belief towards science, it was revealed that students had positive attitudes towards learning science. This result is similar to the findings of Astalini et al. [33] which reported that students in Indonesia have positive attitudes towards learning science. However, Sethi [34] mentioned that there is significant difference between the attitude of rural and urban students towards learning science. Although home is considered as foundational learning place for our students, this study found out that one of the factors influencing students' performance in science is due to poor guidance and support from parents. The result shows that either students' parents were illiterate or not from educational background, therefore, parents were not in position to assist students in learning and completing homework at home. This finding

corroborates with Kapur [35] who concluded that the other factor which influences students science performance are home environment, social background, financial status, provision of tuition and guidance and counselling. Students also highlighted that interpersonal relationship amongst the classmates also have impact on their academic achievement.

## 6. CONCLUSION

This study was aimed to investigate the factors that are influencing the academic performance of class XII science at one of the higher secondary schools in Bhutan. The three main factors revealed through this study were; administrative factor, teaching factor and students attitude and beliefs towards science. Evidences from this study disclosed that students were not convinced by the amount support and guidance provided by the school administration in terms of both academic and non-academic matter. Although students acknowledge the availability of well-setup science laboratories and adequate number of science teachers, the finding shows that some of the science apparatus were not in good condition to perform the experiments and few science teachers were found incompetent in taking science lessons as they were relatively new to the teaching fraternity.

The findings from the study also indicates that students have positive attitude and beliefs towards learning of science. However, students did not received any kind of support from parents and relatives in enhancing their academic performance in science. This can be true as many of the parents were uneducated farmers and few educated parents were not from educational background. The study also found out that student's interpersonal relationship among the classmates directly impact their performance in science or other subjects. Students with good skills in establishing interpersonal relationship among classmates were likely to perform better than those without skills.

## 7. RECOMMENDATIONS AND LIMITATIONS

Based on the findings of this research, this study recommend the school administrations to initiate extra academic related activities like science exhibition that could help the students to apply the conceptual knowledge in real-world situations. School may also recruit experienced and senior teachers to teach classes XI and XII

science and work towards procuring workable and new apparatus for carrying scientific experiments. Furthermore, the study also suggest respective subject teachers to explore and design creative and interactive lessons, so that students could understand the concepts clearly and perform better in the examinations. School and the teachers may interact with the parents and convince them to support students while learning at home.

This study has limitations in terms of sample size. The study was focused only in one school and it is purely based on students' perceptions. Therefore, future researchers may include more population and investigate how strongly students' interpersonal relationship skills impact the performance of students in the school.

### CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the authors.

### ETHICAL APPROVAL

Researchers had obtained proper permission to carry out the study from relevant authorities and officials.

### ACKNOWLEDGEMENT

The researchers would like to thank school administration for permitting us to carry out this study and all the student respondents for their active participation. Thank you every one.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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