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The Effectiveness of Using Padlet Application in Developing Scientific Thinking Skills of Tenth Grade Biology Students

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Abstract

The goal of the current study is to determine whether using the Padlet application may have an effect on how biology students in the tenth grade develop their capacity for scientific thought. The researcher uses a quasi-experimental research design to accomplish the study's goals. 62 pupils in the tenth grade made up the study's participants; they were split into two groups: a control group (n = 31) and an experimental group (n = 31). While the latter is instructed utilizing the Padlet app, the former is instructed conventionally. Pre-post-tests of scientific thinking abilities were used to collect the data, and these tests underwent validity and reliability checks. The results showed that using Padlet to improve students' biology learning performance is helpful. Between the means of the two groups, there were statistically significant differences in favour of the experimental group, which performed better on the post-test. The outcomes also showed a statistically significant difference in favour of the experimental group for both the overall performance of skills and the score of each ability individually on the post-test of scientific thinking skills. The study came to various conclusions in light of the data, the most crucial of which is the requirement to keep using the Padlet app in instruction.

Keywords: Padlet, Scientific Thinking Skills, Biology, Tenth grade.

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1. Introduction

As knowledge regarding human development and learning has grown at a rapid pace, the opportunity to shape more effective educational practices has also increased. Recent decades have seen a dramatically accelerating pace in the development and adoption of new technologies. This rapid technological change is affecting almost every area of the economy, society and culture. Technological innovations have become tools for socializing, communication, doing business, and teaching learning processes that can be extremely effective. Thus, teachers and students today are expected to be fully aware of how to benefit from technology in their classes since electronic applications are no longer a luxury but an important component of the education process for the benefit of future generations.

2. Theoretical framework: Student learning

Learners are always the focus of the educational system that should supports their healthy development, responds to their needs, and addresses their learning barriers. Today, educators try to incorporate self-directed learning as students should be responsible for their own cognitive development. Accordingly, the best type of education approaches is utilizing a mix of learning strategies, since there isn't necessarily one right or wrong learning style. Therefore, by helping students discover different learning methods, their rate and quality learning will be improved (Al Saifi, 2009).

Therefore, it was necessary to find a technique that works to find cooperation between learners with each other on the one hand and with their teachers on the other hand. For this reason, Padlet is considered one of the best applications through which teachers and students interact with each other, give and respond to instruction, convey compliments and opinions, and post materials to make the educational process more vital and interactive (DeWitt, Alias & Siraj 2017).

By providing a single location for a message board, the free digital application Padlet can help instructors and students in the classroom and outside of it. This digital notice board isn't just for text notes; it also has a multimedia note that can display pictures, videos, and documents on a wall that can be made public or private. As a result, students can post on the wall in addition to teachers. The interactive space is a great resource for teachers and students because it's simple to use and accessible from almost any web-browser-capable device. It enables the teacher to communicate with his students, and it enables

the supervisor to communicate with his teachers so that all important news and notes are posted on the electronic wall(Hockett, 2018).

Padlet is believed to be a great platform for sharing digital content; it has undergone several great updates that make it an ideal tool to use with students in class. It is a place where a single or multiple walls can be created and able to house all posts the student wants to share. It enhances collaborative work; multiple people can post to the same wall at the same time. Also, it allows students to easily add notes, text, images, videos, and drawings to their wall that could be evaluated in different ways. (De Berg, 2016).

Besides, it allows participating and responding to others, or just publishing and stopping receiving comments. Furthermore any Padlet wall can be exported in a variety of formats including, PDF, image, or Excel and it works across multiple devices including mobile phones. It also serves the Arabic language, as its basic instructions are translated into Arabic that encourage students to arrange pictures or sentences to form a thought-provoking, emotional and funny story (Al-Zahrani, 2018).

Padlet has also been reported to get students primed for learning and warm up their skills by creating a wall for students to know each other and upload their pictures achievements, hobbies and interests to feel comfortable at the beginning of the school year. It also used to share students' work that was carried out during the session and send the link to involve parents in evaluation, feedback and motivation. Additionally, Padlet is considered a highly effective tool for sharing students' proposals, experiences and group discussions, and posting digital sources and references such as pictures, websites, and videos related to the curriculum to review a lesson or a unit (Abdel Fattah & Khalaf, 2018).

There are several innovative ways to employ Padlet application in teaching, such as presenting an idea or problem by the teacher on the electronic board, and then give students a chance to discuss, express opinions and comments. After completing the brainstorming session, the teacher and his students remove duplicate views, collect similar ideas and choose the appropriate solutions. Moreover, the teacher might create an online board for each student in which all his work and achievements are placed to be easily followed, reviewed and evaluated (Kleinsmith, 2017).

Additionally, Padlet promotes active learning strategies through a board created in the form of concept maps or conceptual diagrams for students who learn better visually to form collaborative groups to put their comments and opinions, and then share them with their classmates. A question bank can also be made for students who have not yet understood the material, and for those who feel shy to ask

questions loudly, as shyness can be bitterly difficult for many students (Padlet Blog, 2013).

To the best of the researcher's knowledge, to date, no studies have been conducted related to the Padlet application and its relationship to scientific thinking, which has been clearly considered as one of the ways of enhancing the seeker's knowledge and helping students become independent thinkers and problem solvers. The present research aims to determine the effect of using the electronic board (Padlet) in developing scientific thinking skills among the tenth grade biology students.

A rock solid piece of evidence can be traced in finding out the effectiveness of Padlet app in teaching. Empirical research on the potential effect of using Padlet application in teaching has yielded effective results.

Dunbar (2017) investigated students' perceptions about the impact of the Padlet usage as an instrument for learning and evaluating the behavioral, emotional, reactive and cognitive participation. The study sample consisted of (27) students in a sociolinguistic course. Padlet application was used as an instrument for learning and evaluation. At the end of the course, a survey and an interview were used to obtain students' feedback on the effectiveness of the Padlet application. The results showed that the use the Padlet promoted active learning and students' participation, and provided positive evaluation experiences that supported their cooperation, and helped create a positive learning atmosphere.

Al-Subaie (2018) conducted a study aimed at examining the impact of using electronic blogs on students' English writing skills, and the development of their vocabulary in Saudi Arabia. The study sample consisted of (40) female students. The study used the experimental design and the quantitative analysis. To collect data, blogs and pre-post-testing were used. The results of the study showed improvement in the students' performance and an expansion of their knowledge after using the blogs.

Kharis et al. (2020) compared the usage of the Padlet app as a microblogging platform for enhancing students' writing skills to the use of traditional media. The study, which took place in Indonesia and lasted one semester, attracted 45 students. Class A students wrote on standard paper sheets. In the meantime, students in class B turned in a project using the Padlet platform. According to the pre-post test data, the results of the students' assignments in the two classrooms did not differ. Thus, it was determined that while using Padlet for microblogging activities in writing did not affect students' writing scores, they did develop new digital abilities and had a great experience overall.

Kleinsmith (2017) examined the effectiveness of Padlet application in increasing students' academic achievement in mathematics. A single-subject design methodology was used. The students' academic achievement was assessed through daily assessments. The results indicated that the use of the Padlet app increased students' academic engagement and achievement.

Al-Awadin, Abdel-Karim and Saad (2017) investigated the effectiveness of Padlet application in students' academic writing, and their perception of using it as an educational tool for writing in English as a second language. The study concluded that public university students achieved better performance in English writing after integrating the Padlet in their classrooms. Since students' shyness cannot be eliminated solely through the formal classroom learning and causes negative impacts towards students' development, the results indicated that the use Padlet helped shy students express their ideas and enhance their skills, especially in cooperation, interaction and writing.

In light of the forgoing, it can be felt that most previous studies stressed on the effectiveness of Padlet application in teaching and the fruitful results that could be gained. Most of the surveyed studies showed that Padlet improved learners' performance, gave them several chances to collaborate in which they became capable of sharing their thoughts and feelings, offered them not only a joyful environment, but also an effective environment in which they are able to exchange and share educative information.

3. Problem of the study

The conventional methods used by the majority of teachers in general, and science teachers in particular still utilize one medium to serve the teaching materials. Over the time, this method of teaching becomes monotonous and thus student gets bored by this form of teaching and the technological gap between students and teachers is widening as a large section of the teaching community is still resisting the use of technology in learning. Today’s students expect teachers to go with their space of interest instead of teaching them by the same old boring method that depends on memorization and indoctrination. Since the prime role of education is to mold students and make them overall developers. The technology-based learning methods should produce students able to learn for life and practice thinking scientifically.

Through the researcher's experience in teaching and supervision, it was noted that many science teachers do not use modern strategies to engage students using technology in developing scientific thinking, because they lack deep knowledge and experience of many educational applications (such as Padlet) and how to employ them.

Consequently, it was necessary to use a teaching method that caters for individual differences, addresses the weaknesses, deficiencies and the emerging low level of students and equips them with the skills necessary for success.

Accordingly, a teaching method was sought that fits their way of thinking and helps them to employ knowledge in life functionally. On the other hand, the teacher has the major responsibility in formulating and asking questions that explore their knowledge and raise their level of thinking. The researcher believes that using Padlet application as a means of effective dialogue, may lead to the development of students' level of scientific thinking. So, the current study seeks to answer the following overarching question: What is the effectiveness of using Padlet application in developing the scientific thinking skills of tenth grade biology students? Two supplementary questions drove the collection of the subsequent data:

1- Does the performance of the tenth grade biology students differ in the test of scientific thinking skills as a whole according to the teaching method (Padlet, conventional)?

2- Does the performance of the tenth grade biology students differ in each skill of scientific thinking according to the teaching method (Padlet, conventional)?

4. Significance of the study

After reviewing the studies about Padlet app, it was valued as extremely important in the teaching learning process. The findings of the study are expected to contribute to educational literature by providing potentially significant information and new insights on the effectiveness of using Padlet application in developing students' scientific thinking skills and coping with the recent trends in teaching biology. Also, the test developed in the study could be used by teachers and researchers in measuring scientific thinking skills among students. Even though ample and international research has been conducted on using Padlet application in education, to the best of the researcher' knowledge Padlet usage in developing scientific thinking skills in Arab region hasn’t been attempted. Practically, curricula designers may benefit from this study by changing the textbooks and by injecting material that emphasize using technology such as Padlet app in their teaching. In fact, it is crystal clear how the educational systems call for integrating technology in teaching biology and claims to apply it; however, reality is a different story, indeed.

5. Operational definitions

The following terms will have the associated meaning whenever encountered in the study:

Effectiveness: is resulting changes to the dependent variable (scientific thinking) through applying the independent variable (Padlet).

Scientific thinking: is a set of basic operations (observation, classification, prediction, inference) applied on tenth grade students, and measured by the degree obtained in the scientific thinking test developed in the study.

Limitations of the study

The generalizability of the findings may be limited by the following considerations:

1- The study is restricted to the tenth grade students in schools affiliated to the University District in the capital Amman of the academic year (2020/2021)

2- The educational material is the third unit (mycology) from the biology textbook for the tenth grade (2020/2021).

3- The extent of the validity and reliability of the instrument used in this study.

4- How serious students are in responding to the study instrument.

6. Methodology and Procedures

First: Methodology

The current study follows a quasi-experimental pre-posttests research design; as the aim of this study is to identify the effect of Padlet application against the conventional method in teaching scientific thinking skills.

Second: participants of the study

62 tenth grade students (composing experimental and control groups of 31each) from the university district in the capital Amman of the academic year (2020/2021) were chosen by the availability sampling method.

Study instrument and educational material

Based on the extensive review of literature, a test of (20) multiple choice items were developed. The apparent validity of the test was verified by a panel of specialized professors and teachers who teach biology for the tenth grade whose comments and observations were taken into consideration in amending the final version of the instrument. To check the reliability of the test, it was applied to a pilot study of 25 students. The test reliability coefficient was estimated

using the internal consistency method of the Coder-Richardson equation (KR-20) and found (0.87) which was considered suitable to conduct the study.

In order to reveal the paragraphs that fall within the educationally acceptable range of difficulty and discrimination, the item difficulty and item discrimination were measured for each paragraph of the test. Table 1 shows item difficulty and item discrimination for each paragraph of the scientific thinking skills test.

Table 1: item difficulty and item discrimination for each paragraph of the scientific thinking skills test

Item no	Item difficulty	Item discrimination
1	0.62	0.46
2	0.46	0.52
3	0.51	0.37
4	0.48	0.78
5	0.46	0.62
6	0.42	0.46
7	0.71	0.52
8	0.52	0.45
9	0.48	0.52
10	0.56	0.70
11	0.52	0.62
12	0.52	0.56
13	0.39	0.45
14	0.47	0.39
15	0.70	0.75
16	0.62	0.62
17	0.66	0.46
18	0.56	0.70
19	0.52	0.62
20	0.52	0.56

Table 1 shows that the values of the difficulty for the test items ranged between (0.42) - (0.71), and the values of the discrimination ranged between (0.37-0.75). According to the criteria for accepting paragraphs referred to by (Odeh, 2010) these values were found educationally acceptable and thus, the number of test items in its final form is (20), the maximum score is (20), and the minimum is (zero).

Table 2: Distribution of the test items in its preliminary form on the skills of science operations

Science operations	Item no	Number of paragraphs
Observation	15،9،13،17،	5

Classification	2،6،10،14،18	5
Prediction	11،15،19 ،7 ،3	5
Inference	20،16،12 ،8 ،4	5
Total		20

Educational material

The Mycology unit was selected from the biology textbook for the tenth grade, the experimental educational material was prepared by reviewing the theoretical literature and studies that addressed teaching through using Padlet application, then the scientific content was analyzed to find facts, concepts and generalizations, supported by enrichment activities.

Study procedures

The following procedures were carried out in the course of the study:

1- Preparing the educational material in biology for the tenth grade, according to the Padlet application method.

2- Preparing the study instrument and checking its validity and reliability.

3- Training teachers how to teach the experimental group and how to use and implement the lesson notes prepared by the researcher.

4- Applying the post scientific thinking skills after completing the teaching of the experimental and control groups separately.

5- The results of the study were obtained through appropriate statistical analyses using SPSS statistics.

6- The findings of the study were analyzed and discussed according to the questions of the study.

7- The recommendations were set based of the results of the study.

Statistical treatment

In order to answer the questions of the study, the means and standard deviations of the study participants were calculated to compare their scores in the scientific thinking skills test in the two groups.

Study variables

To determine the potential effect of using Padlet application in developing the scientific thinking skills, the current study used the teaching method (two levels: teaching through the Padlet app, teaching through the conventional method) as the independent variable to determine their impact on the dependent variable which is the students' performance in the scientific thinking skills test.

7. Study Findings

The first question sought if the performance of the tenth grade biology students in the scientific thinking test differs according to the teaching method (Padlet app, the conventional method)? The null hypothesis emerged from this question states that "there are no statistically significant differences between the mean scores of the tenth grade biology students' performance when ($\alpha = 0.05$) in the two groups due to the teaching method.

To answer this question and test its hypothesis, the mean scores and standard deviations of the students' performance on the pre and post test were calculated according to the teaching method (Padlet app, the conventional method) as shown in Table 3 below:

Table 3: The mean scores and standard deviations of the students' scores in the post-scientific thinking test according to the teaching method

Pre- performance			Post-performance			
Teaching method	Mean	SD	Mean	SD	Average mean	Standard error
Padlet	6.88	2.22	16.11	3.03	16.11	0.73
Conventional	6.18	2.48	11.27	2.79	11.27	0.79

Highest grade (20)

Table 3 shows an apparent difference between the pre and post mean scores of the experimental group who were instructed through the Padlet app and an apparent difference in the post mean scores between the performance of control and experimental groups. It is possible that the significant differences shown on the post-test mean scores of the groups could have resulted from the pre-existing group differences other than the treatment effect, and to find out whether the statistical significance of the mean scores difference related to the teaching method, one-way ANCOVA analysis was used, as shown in Table 4.

Table 4: one-way ANCOVA analysis of the students' post-test mean scores on the overall scientific thinking skills according to the teaching method:

#	Source	Type sum of squares	df	Mean square	F	Siq (P)	Eta squared η2
1	Pre- test	21.997	1	21.997			
2	Teaching method	332.111	1	332.111	*37.843*	**0.000*	*0.349*
3	Error	507.658	59	8.776			
4	Total	855.380	61				

Statistically significant at ($\alpha = 0.05$)

Table 4 shows that the P value of the teaching method reached (0.000), which is less than the level of statistical significance ($\alpha = 0.05$). Thus, the null hypothesis related to overall scientific thinking skills was rejected, and the alternative was accepted, which states: "There is a statistically significance difference at ($\alpha = 0.05$) between the two mean scores of the students' performance in the test of overall scientific thinking skills. The mean score difference of the groups were statistically significant in favor of the experimental group attributed to the Padlet teaching method, F (37.843) $p<0.05$. The effect size of the teaching method variable in developing scientific thinking skills is large ($\eta 2 = 0.349$) the larger the effect size the stronger the relationship between two variables. which means that (34.9%) of the improvement in the students' performance in the post-test is attributed to the effect of employing the Padlet app.

What explains the preference of the Padlet over the conventional method is that it encourages shifting from predominantly 'teacher-centered' to more 'learner-centered' classrooms, in which students actively construct their own knowledge, shoulder the responsibility of learning and learn from and with each other. Furthermore, students learn by experiences and active involvement, engage regularly in communication and group research, they will also avail the opportunity to show their creative work with other class fellow and interact positively with the educational situation, compared to the conventional method that relies mainly on textbook, learns through memorization and recitation techniques, focuses on rote learning and engages students in passive tasks.

It can also be attributed to the fact that Padlet app helped the students recall information, express ideas and gave them a wider audience for the work they produce i.e. their classmates and parents. Moreover, they can receive feedback on their work, as well as look back at previous work to identify progress which has in turn raised their level of achievement.

Besides, Padlet app might have played a role in developing scientific thinking skills through enrichment activities that helped students to move away from randomness and deal with thinking in an organized manner, using classification, prediction and inference which are the basis for scientific thinking skills.

Additionally, using Padlet increased the learner's positive participation, as he accesses knowledge by himself and can classify, predict, compare, assume, and find solutions and alternatives. The student actually builds his knowledge on his own by using mental processes and thinking skills in a positive way, which contribute to fruitful interaction during the implementation of the lessons as he has the essential knowledge and has the opportunity to think.

This result goes in line with Dunbar (2017) who showed that using Padlet promoted active learning and students' participation, and helped create a positive learning atmosphere. Kleinsmith (2017) indicated that utilizing Padlet app helped increase students' academic achievement and teach them basic skills. Al-Awadin, Abdel-Karim and Saad (2017) indicated that the use of Padlet helped shy students express their ideas and enhance their various skills. On the contrary, the current study implicitly disagreed with (Kharis, et al, 2020), which showed that the Padlet did not affect the student's writing results.

The second research question sought if the performance of the tenth grade biology students differ in each skill of scientific thinking (observation, classification, prediction, inference) according to the teaching method (Padlet, conventional)? The null hypothesis emerged from the question states that "there are no statistically significant differences between the mean scores of the tenth grade biology students' performance when ($\alpha = 0.05$) in the two groups on each scientific thinking skill attributed to the teaching method.

To answer this question, and the accompanying hypothesis, the significance of difference between the two means for the students' performance on each scientific thinking skill (observation, classification, prediction, inference) was verified.

The means and standard deviations of the students' performance in the pre, post, and modified post tests for each scientific thinking skill (observation, classification, prediction, inference) according to the teaching method, were calculated as shown in Table 5.

Table 5: The two means and standard deviations of the students' performance in the pre, post, and modified post tests for each scientific thinking according to the teaching method.

Skill	Teaching method	Pre-performance		Post-performance		Pre-modified performance	
		Mean	SD	Mean	SD	Modified mean	St error
Observation(5)	Conventional	1.89	1.29	2.38	1.19	2.52	0.21
	Padlet	2.23	1.35	3.75	1.06	3.60	0.19
	Total	2.07	1.31	3.10	1.28		
Classification(5)	Conventional	1.39	0.98	2.15	1.15	2.17	0.28
	Padlet	2.11	1.19	4.33	1.73	4.35	0.25
	Total	1.78	1.10	3.29	1.84		
Prediction(5)	Conventional	1.93	1.31	2.50	1.40	2.48	0.24
	Padlet	1.69	1.19	3.70	1.21	3.69	0.23

	Total	1.79	1.22	3.10	1.42		
Inference(5)	Conventional	1.58	1.11	2.49	1.21	2.57	0.25
	Padlet	2.00	1.17	4.17	1.45	4.11	0.23
	Total	1.91	1.18	3.36	1.60		

Table 5 shows apparent differences in the post mean scores between the performance of the control and experimental groups.

In order to find out the statistical significance of the post differences according to the teaching method, (after neutralizing the impact of the pre-differences in the performance of the two groups on each scientific thinking skill: observation, classification, prediction, conclusion), one way MANCOVA was used as shown in Table (6).

Table 6: Results of one way MANCOVA analysis for the post mean scores of the students' performance on each scientific thinking skill, according to the teaching method.

Source	Skill	Type sum of squares	df	Mean square	F	Siq (P)	Eta squared η2
Pre- observation	observation	0.643	1	0.643	0.572	0.45	
	classification	1.477	1	1.477	0.714	0.40	
	prediction	0.194	1	0.194	0.128	0.72	
	inference	5.216	1	5.216	3.128	0.08	
Pre-classification	observation	6.740	1	6.740	6.011	0.01	
	classification	2.854	1	2.854	1.380	0.25	
	prediction	3.498	1	3.498	2.301	0.14	
	inference	4.939	1	4.939	2.962	0.09	
Pre-prediction	observation	0.099	1	0.099	0.088	0.77	
	classification	7.519	1	7.519	3.636	0.06	
	prediction	1.486	1	1.486	0.977	0.32	
	inference	1.411	1	1.411	0.846	0.36	
Pre-inference	observation	2.710	1	2.710	2.416	0.13	
	classification	0.693	1	0.693	0.335	0.57	
	prediction	12.969	1	12.969	8.530	0.01	
	inference	0.033	1	0.033	0.020	0.89	
Teaching method	observation	15.663	1	15.663	*13.861	*0.000*	*0.189*
	classification	65.699	1	65.699	*30.960	*0.000*	*0.349*
	prediction	19.737	1	19.737	*12.183	*0.001*	*0.180*
	inference	31.171	1	31.171	*17.924	*0.000*	*0.239*
Error	observation	63.333	56	1.130			
	classification	119.009	56	2.122			
	prediction	91.209	56	1.620			
	inference	97.401	56	1.739			

Modified total	observation	88.358	61
	classification	213.846	61
	prediction	197.851	61
	inference	142.862	61

Statistically significant at ($\alpha = 0.05$)

Table 6 shows that P values for the teaching method and the scientific skills are less than the level of statistical significance ($\alpha = 0.05$). Therefore, the second null hypothesis is rejected, and the alternative is accepted, which states that "there are statistically significant differences between the mean scores of the tenth grade biology students' performance when ($\alpha = 0.05$) in the two groups on each scientific thinking skill attributed to the teaching method (Padlet, conventional).

The statistically significant difference was in favor of the experimental group, who was instructed by the Padlet app, with higher modified mean scores than the control group who was instructed conventionally. By using Eta Square, the effect size of each skill (observation, classification, prediction, and inference) was found (0.189, 0.349, 0.180, 0.239) respectively, which means that (18.9%, 34.9%, 18.0%, 23.9%) of the improvement in the students' post-performance on each scientific thinking skill is attributed to the Padlet app.

This result may be attributed to the novelty of the Padlet app which is a versatile and intuitive virtual post board that can share pictures and videos in class or as an extension to their learning. The various teaching methods provided by the Padlet such as discussion board; class blog; group portfolio and group exercise helped students to be involved in active learning and to observe, predict and use multi sense learning, which led to the development of scientific thinking skills.

8. Conclusion

This paper has engaged in The effectiveness of using Padlet application in developing scientific thinking skills of tenth grade biology students in Amman the capital. Essentially, the study found that using the Padlet application is effective in enhancing student achievement in biology learning, as the study findings indicated that student interacted effectively with the lessons using the Padlet, these findings suggested a Further research needs be carried out on the impact of Padlet pp on different educational stages, and deals with other variables such as: the acquisition of scientific concepts, the extent to which students retain them, scientific trends, critical and creative thinking. Moreover, Training pre- and in-service teachers to employ the Padlet app in teaching biology, designing scientific situations and

integrate them within the curriculum. Finally, the study recommended that the textbook writers and policy makers incorporate situations that require the scientific method of thinking in tenth grade biology curriculum in addition to scientific c knowledge.

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