

# The Use of Technology in the Delivery of Instruction in Public Schools

**Rosenda Alicwas Berry**

Permanent Teacher, Department of Education

## **Abstract**

This study explores the adoption of emerging technologies, particularly IoT, by teachers and the associated benefits and challenges in instructional delivery across three schools in the Eastern part of La Trinidad District. Data was gathered via surveys and analyzed using descriptive statistics.

The findings indicate that teachers predominantly utilize smart TVs, laptops, and desktops for instruction, citing benefits such as increased student engagement, heightened excitement in teaching and learning, and fostering student proactivity and creativity. However, challenges persist, including insufficient teacher familiarity with new technologies, limited student access to the internet, and the need for enhanced mentoring or training to effectively utilize these tools.

In response, the study recommends prioritizing professional development opportunities for teachers to effectively integrate technologies into their teaching methodologies. This proactive approach aims to bridge the gap between technology adoption and instructional implementation, ultimately enhancing the quality of education delivery in the digital age.

**Keywords:** IoT devices, Interactive-learning, Data-driven instruction, and engagement

## **INTRODUCTION**

### **Background of the Study**

The Internet of Things (IoT) was officially coined in 1999, by the year 2013, the IoT had become a system using multiple technologies, ranging from the internet to wireless communication. But nowadays, IoT has become an important communications tool for teaching and learning. According to a report by International Society for Technology in Education (ISTE), IoT in education refers to the integration of smart devices, sensors, and data analytics to enhance teaching and learning process (ISTE, 2020).

With this, according to Kajal (2020) internet plays a very vital role. With the internet, it makes learning easier for students as well as teachers because they can research information and it makes teaching and learning simpler. The teachers can transform static lessons into engaging multimedia experiences, where students actively participate, interact, and explore content in innovative ways.

According to Trivedi (2023), he viewed that technology is a powerful tool for education, providing educators with the opportunity to create engaging and interactive learning experiences. Teachers can make profound changes in their teaching methods and create opportunities for collaboration and engagement. Similarly, according to Zhera & Bilwani (2016), technology has become a tool that can greatly help in the teaching and learning process because it makes the learning processes easy and enjoyable. Importantly, when digital learning tools are effectively utilized (Mastul, 2023).

In a study by Atanacio & De Guzman (2020), the use of technology has been found to have a positive impact on student learning outcomes. The use of educational technology such as tablets and online resources can improve student engagement and motivation. The author also noted that teachers who integrate technology into their instruction reported feeling more confident in their ability to teach and engage their students. Similarly, in a study by Abrigo, Ocdol, & Sadia (2019), they found that technology integration has resulted in improved student engagement and performance. However, the authors noted that challenges to technology integration in the Philippines include a lack of resources and infrastructure, adequate teacher training and carrying levels of technological competency among teachers.

Furthermore, there are several benefits of IoT in education. These are enumerated in the study of Safdar, Hafeez, and Malik (2024). IoT helps in improving the quality of teaching and learning process by providing an engaging, collaborative, and content-creating environment; It has provided collaborative teaching learning process; It also helps student create smart learning environment; It helps teachers prepare smart lesson plans and provides personalized content and understand student learning aspects and performance. Besides, according to Dixit (2024), IoT makes teaching processes scientific, objective, clear, simple, easy, interesting, and effective. When teachers used IoT devices in teaching their lessons, they made the process easy and possible.

However, there are challenges faced by teachers in using technologies in Philippine Education. One of the challenges as cited by Dublar in her study "Assessing the Impact of Emerging Technology on Knowledge and Skills Acquisition of K -12 Students in the Philippines: Systematic Literature Review" is the lack of infrastructure and resources. Inadequate internet connectivity and limited access to devices and software hinder the effective implementation of technology in the classroom. Besides, in a study by Mastul, De Vera and Jayne, (2023), they found that lack of necessary infrastructure, teacher training and experience in using technology, cost of educational technology, there is a digital divide between urban and rural areas, some teachers and administrators may resist the integration of the technology in the classroom due to perceived threat to the traditional teaching methods and technical difficulties are the challenges in using technology in the classroom.

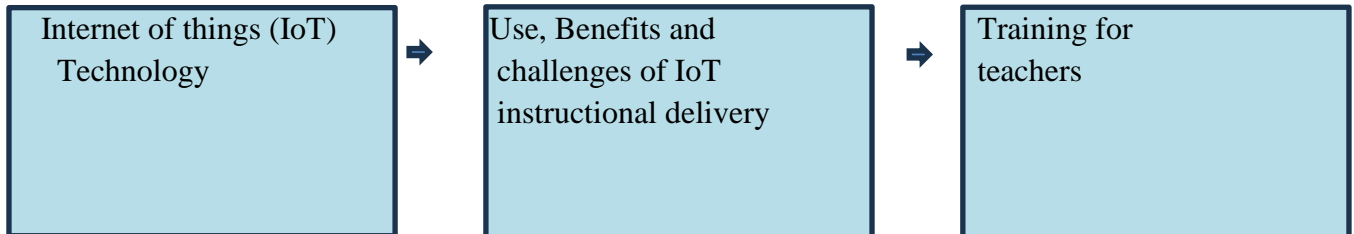
With the benefits and challenges in using the IoT technology, the researcher aims to determine the emerging technologies used by the teachers, specifically the IoT, the benefits and the challenges faced by teachers in the delivery of instruction. using such technologies.

This study is essential in helping educators and policymakers make informed decisions on how to effectively integrate technology to improve the teaching and learning process, it provides insight for school administrators for implementing training sessions for teachers to be technologically- responsive. It gives emphasis to the development of the latest methods for effective education, it provides proper guidance to make the teaching/ learning process effective, and it provides input for the teachers to be adaptive on the IoT technology for teaching.

### **Conceptual Framework**

The conceptual framework of this study depicted the use of emerging technology, specifically. IoT technologies in the delivery of instruction in public schools. The process continues with the following steps: It starts with the emerging IoT technologies used by the teachers; the use and extent use of the technology applications; the benefits of IoT technologies in using it; And it ends with the challenges faced by the teachers in using such technologies. Then, based on the results, training for teachers shall be made to enhance quality teaching and learning process through integration of technology in the delivery of instructions and it is hoped that it will bear a professional development of teachers in public schools. That,

with IoT technologies, teachers can create online lessons and interactive activities to achieve new levels of productivity, expand learning opportunities for students and improve their instructional methods and personalize learning. Thus, this framework has guided this research in determining the use of IoT technologies in the delivery of instructions in public schools.



**Figure 1: Conceptual Framework**

**Statement of Problem**

This study aims to determine the emerging IoT technology in public schools used in the delivery of instructions.

Specifically, the following questions as follows:

1. What emerging IoT technologies are used by the teachers in the delivery of instruction?
2. What are the IoT technology applications used in the delivery of instruction?
3. To what extent do teachers use IoT technology applications in the delivery of instruction?
4. What are the benefits of using IoT technologies in the delivery of instruction?
5. What are the challenges faced by the teachers in using IoT technologies in the delivery of instruction?

**METHODOLOGY**

**Research Design**

The research study used a descriptive quantitative research design. The design used to obtain information concerning the status of IoT technology used by the teachers in Public Schools.

**Population and Locale of the Study**

The study conducted in three (3) big to medium schools in Eastern part of La Trinidad as the respondents (Table 1) specifically, Tacdian Elementary school, Bahong Elementary School, and Don Pulas Elementary School.

**Table1. The Respondents**

Schools	Respondents	Percentage
Tacdian Elementary School	19	40%
Alapang Elementary schools	17	35%
Bahong Elementary Schools	12	25%
Total	48	100%

**Data Collection Instruments**

Partly of the instrument adopted the questionnaire of Javier (2020), The Practices of Filipino Public High School Teachers on Digital Teaching and Learning Technologies During Covid Pandemic: Basis for Action Learning Cell Sessions. The instrument has undergone content validity by three (3) experts. A test-retest method was also conducted to measure the reliability of the questionnaire. It has 49 items with 5 subscales. Emerging technology has 13 items; the use of technology and the extent do teachers use of

the applications of the IoT technology have 10 items; and the benefits of IoT technology and the challenges in using IoT technology have 8 items.

**Data Collection Procedure**

Before the conduct of the study, the researcher wrote to the Schools Division Superintendent of Benguet (SDS) seeking permission to allow the researcher to in administering the questionnaires to the identified respondents.

**Treatment of Data**

The data gathered were tabulated and statistically treated using descriptive statistics.

To determine the emerging IoT technologies used by the teachers; the use of technologies, the benefits of using IoT technology; and the challenges faced by the teachers in using IoT technology; Frequency count, percentage, and weighted mean were used.

To determine the extent do teachers use the IoT technology applications in the delivery of instruction, the following scales and interpretations were used.

Relative Value	Statistical Limit	Descriptive Equivalent
5	4.21-5.0	Always used
4	3.41-4.20	Often used
3	2.61-3.40	Sometimes used
2	1.81-2.60	Rarely used
1	1.00-1.80	Never used

**RESULT AND DISCUSSION**

There were 48 teachers of Tacdian Elementary School, Bahong Elementary School, and Don Pulas Elementary School who participated in the study and all with valid responses as presented in table 1. The plurality of respondents belongs to Tacdian Elementary School, followed by Don Pulas Elementary School, and lastly, Bahong Elementary School. Meanwhile, majority of the respondents were teachers in higher grades who held a Master of Arts in Education degree.

**Table 1. Respondent Profile**

Variable	Category	F(n=48)	Percentage
<b>School</b>	Tacdian Elementary School	19	
	Bahong Elementary School	12	
	Don Pulas Elementary School	17	
<b>Grade Level</b>	K-3	21	
	4-6	27	
<b>Highest Education Attained</b>	Bachelor’s Degree	11	
	MaEd	15	
	Ed.D/PhD	2	

**The Emerging IoT Technologies Used by the Teachers in the Delivery of Instruction**

Surprisingly, the utmost emerging IoT technology used by the teachers in the delivery of instruction was “smart TV” with 48 responses as shown in table 2. This reveals that smart tv has a substantial impact on teaching and learning. It is considered highly influential and beneficial in educational settings, contributing significantly to the overall teaching experience. It offers versatile functionality that supports a wide range of educational activities and it provide access to wide range of online resources, educational websites,

digital libraries, and educational apps directly from classroom environment. This access facilitates seamless integration of digital content into lessons and enhances to supplemental learning materials.

“Laptop” was the second emerging technology used by the teachers with 40 responses. This indicates that laptop was considered highly important or significant among emerging technologies. Laptop was valued for their versatility and flexibility in educational context. It was used for various purposes, such as creating lesson plans, delivering multimedia presentations, accessing digital resources, conducting research, grading assignments, and communicating with students and colleagues.

**Table 2. The Emerging IoT Technology used by the teachers**

Variable	Category	F(n=48)
<b>Smart phone internet -enable</b>	Yes	16
	No	32
<b>Laptop</b>	Yes	40
	No	8
<b>Smart TV</b>	Yes	48
	No	0
<b>Smart Watch</b>	Yes	2
	No	46
<b>Wireless Audio devices</b>	Yes	9
	No	39
		9
<b>Smart board</b>	Yes	3
	No	45
<b>Tablet</b>	Yes	5
	No	43
<b>Desktop</b>	Yes	20
	No	28
<b>Smart Classroom</b>	Yes	0
	No	48
<b>AI camera</b>	Yes	1
	No	47
<b>Pen Scanner</b>	Yes	0
	No	48
<b>Magic Card</b>	Yes	2
	No	46
<b>E-books</b>	Yes	5
	No	43

“Desktop” was the third emerging technology utilized by the teachers. This implies that desktop computers typically offer more functionality, processing power, and capabilities in creating interactive content that teachers can create engaging and visually appealing lessons. Then, smartphone, wireless and audio devices, tablet magic card, e- books and AI camera were slightly used by the teachers because they may be less inclined to integrate these technologies extensively into their instructional practices. These may be due to limited availability of devices. Teachers may prioritize technologies that align more closely with

pedagogical approaches and teaching styles and may be these technologies offer unique opportunities for enhancing and teaching and learning.

On the other hand, smart classroom and pen scanner were the lowest ranked with no responses. This implies that public elementary schools may not have the smart classrooms and pen scanner due to infrastructure limitations, budget constraints, technical expertise, or lack of comprehensive plans for technology integration.

Besides, teachers are not ready to implement smart classroom technology because this advancement of technology requires training and professional development for teachers.

### **The IoT Applications Used by the Teachers in the Delivery of Instructions**

Based on the result as presented in table 3, the widely used IoT applications by the teachers was Learning Management System (LMS) which has 38 responses. This implies that teachers have the knowledge in using LMS in the teaching learning process.

The result reveals that teachers were adapting to online and blended learning models. They employ LMS platforms to deliver instruction effectively both traditional classroom and virtual settings.

<b>Variable</b>	<b>F(n=48)</b>	<b>Ranks</b>
<b>1. Interactive whiteboard</b>	25	5
<b>2. Educational apps</b>	35	2
<b>3. Learning Management System</b>	38	1
<b>4. Virtual reality</b>	4	8
<b>5. Adaptive learning platform</b>	15	7
<b>6. Online collaborative tools</b>	17	6
<b>7. Digital textbook</b>	2	9
<b>8. Podcast &amp; multimedia resources</b>	29	3
<b>9. Coding and robotics</b>	0	10
<b>10. Gamification</b>	26	4

The second most utilized technology application was educational apps. This emphasizes that educational apps can be accessed on various devices such as smartphones, tablets, and computers, making learning resources readily available to students both inside and outside the classroom. The apps allow teachers to provide differentiated instruction by offering activities and content at different levels of complexity to meet the diverse needs of students. It offers flexibility in lesson delivery, allowing teachers to integrate digital resources, multimedia content, and interactive exercises seamlessly into their teaching plans.

Podcast and multimedia resources was the third ranked. This means that teachers provide audiovisual content in the teaching and learning process to make learning more interactive, stimulating, and memorable. However, coding and robotics ranked lowest in terms of usage by teachers in the delivery of instruction due to lack of resources. It is possible that schools face resource constraints, such as budget limitations to have the equipment and materials, which this hinders the integration of coding and robotics into the curriculum. With this, the skills in manipulating the technology applications were not yet widespread among teachers.



### The Extent Use of IoT Technology Applications in the Delivery of Instruction

Generally, as shown in table 4, the extent use of IoT technology applications by teachers was “sometimes used” as indicated by its overall mean score of 2.62.

The result implies that IoT technologies were not consistency integrated by the teachers in their teaching practices but were utilized periodically or situationally.

<b>Variable</b>	<b>Weighted Mean</b>	<b>Verbal Interpretation</b>
<b>1. Interactive whiteboard</b>	2.50	Rarely Used
<b>2. Educational apps</b>	3.75	Often Used
<b>3. Learning Management System</b>	3.85	Often Used
<b>4. Virtual reality</b>	2.41	Rarely Used
<b>5. Adaptive learning platform</b>	1.67	Rarely Used
<b>6. Online collaborative tools</b>	2.57	Rarely Used
<b>7. Digital textbook</b>	1.56	Rarely Used
<b>8. Podcast &amp; multimedia resources</b>	3.75	Often Used
<b>9. Coding and robotics</b>	1.43	Never Used
<b>10. Gamification</b>	2.75	Sometimes Used
<b>Overall</b>	2.62	Sometimes used

However, in specific area, the IoT technology applications used by the teachers with the highest mean score of 3.85 was “learning management system”. This implies that teachers can efficiently organized and managed course materials, resources, assignments, and assessments in one central form. They can upload learning materials, multimedia resources, lecture notes, and instructional videos, and making them accessible to students anytime. They can create engaging and interactive lessons, quizzes, discussions, and collaborative projects, catering to diverse learning styles and preferences. They can track students’ progress, assess learning outcomes, provide personalized feedback, and offer tailored learning resources to meet student needs and learning.

Then, educational apps with high mean score of 3.75. This means that teachers were trained in utilizing educational apps effectively. They prioritized active student engagement and participation in lessons because it facilitates interactive learning experiences, collaborative activities, problem-solving tasks, and hands on exploration, promoting deeper understanding and retention concepts.

Subsequently, gamification with the mean score of 2.75. This implies that teachers occasionally utilized gamification in their teaching strategies. Teachers may face time constraints due to curriculum demands, limited class time, or there are instructional priorities. Gamification may not align with every lesson or learning objective. Teachers carefully consider when and how to incorporate gamified elements based on the content, student needs, and desired learning outcomes and they need to balance gamified activities with other instructional approaches to cater diverse learning styles and preferences within the classroom. Unsurprisingly, the result reveals that teachers did not use coding and robotics. This indicates that teachers may have limited exposure or familiarity with coding and robotics concepts tools and resources. This could be lack of training, professional opportunities or access to relevant educational materials. Teachers may find it challenging to implement coding and robotics effectively.

**The Benefits in the Use of IoT Technology in the Delivery of Instruction**

Table 5 shows the ranked benefits in utilizing the IoT Technology in the delivery of instruction by the teachers. Based on the result, “Learners are engaging in the class” was the highest ranked with 43 responses and followed by “it makes teaching and learning exciting” with 37 responses. This implies that when the teachers used IoT technology, the learners are more actively involved in the learning process, leading to improved attention, motivation, and retention of knowledge with the use of technology.

It reveals that the use of IoT technology by the teachers can encourage active participation among students by providing interactive content, real-time feedback, and collaborative learning opportunities. Besides, teachers find their class with enthusiasm, energy, and a genuine passion for the subject matter that the technology contributes to a positive classroom atmosphere that can boost student motivation, participation, and enjoyment in the learning process. Teachers more likely capture student’s interest and attention, leading to higher levels of student engagement.

The next in ranked was “learners become proactive and active”. This indicates that when teachers utilized technology in the teaching and learning process, the learners are taking more initiative and engaging more actively in the learning process. Learners are taking responsibility for pre- learning materials, and actively participating in the discussion. It implies that learners are actively seeking out resources, setting learning goals, and managing their time effectively.

<b>Variable</b>	<b>F(n=48)</b>	<b>Ranks</b>
<b>1. It makes teaching and learning exciting</b>	37	2
<b>2. Learners are engaging in the class</b>	43	1
<b>3. learners become proactive and creative</b>	29	3
<b>4. It adds pride to being proficient or knowledgeable using education 4.0 tools</b>	21	5
<b>5. Improved my technical competencies as teacher</b>	19	6
<b>6. Convenient and easy to manipulate</b>	15	8
<b>7. It is portable and widely available from the internet</b>	17	7
<b>8. teachers discovers new methodologies and strategies</b>	24	4

However, the lowest ranked was “convenient and easy to manipulate” with 15 responses. This implies that there may be a learning curve involved in understanding how to use and manipulate the IoT devices effectively. Integrating IoT devices into existing teaching practices and curriculum may require planning, training, and adjustment to instructional methods.

**The Challenges in Using IoT Technology in the Delivery of Instruction**

With the integration of IoT technology in the delivery of instruction, there are challenges hampered in utilizing technologies in the classroom settings. Table 6 shows that the greatest challenges as experienced by teachers was “Not all teachers are updated with technologies” with 43 responses. This implies that some teachers may rely on traditional teaching methods, they may struggle to integrate digital tools effectively into their teaching practices, there may be a lack of familiar with new technologies that can result to a skill gap among teachers, and may be without adequate support and training, teachers may struggle to keep pace with technological advancements in education.



Furthermore, “not all learners have access to internet” was the second ranked which has 41 responses. This indicates that lack of internet access for some learners creates inequities in learning opportunities and learners without reliable internet access is a challenge for both teachers and students. This is because accessing online resources, participating in virtual learning, or engaging in digital learning activities are challenging tasks.

Subsequently, needs more mentoring or training to fully grasp the use of such tools which has 40 responses. This means that teachers may require additional training and mentorship to develop the skills necessary for effectively using technology tool in their teaching practices. The challenge suggests that ongoing professional development is crucial for educators to stay with evolving technologies and pedagogical approaches. Training and mentoring programs can help teachers build confidence, proficiency, and innovative teaching strategies using technology. Teachers may need support in understanding how to align technology tool with pedagogical goals and instructional objectives.

Moreover, the result highlights the importance of enhancing teacher’s digital literacy skills, including information literacy, media literacy, digital communication, and critical thinking in digital environments.

<b>Variable</b>	<b>F(n=48)</b>	<b>Ranks</b>
<b>1. Internet connectivity issues in the area</b>	8	8
<b>2. Not all learners have access to internet</b>	41	2
<b>3. Needs more mentoring or training to fully grasp the use of such tools</b>	40	3
<b>4. Learners are not more engaging in discussions attention spans are short</b>	32	6
<b>5. Teachers carry the burden of the internet connection cost</b>	27	7
<b>6. Lack of school -based ICT equipment</b>	36	5
<b>7. Not all teachers are updated with technologies</b>	43	1
<b>8. Many preparations of contents presentations</b>	37	4

However, the lowest ranked was “Internet connectivity issues in the area” with 8 responses. The result reveals that teachers have consistent access to the internet, which essential for technology- enhanced learning. There may be relatively stable and reliable internet infrastructure, which is a positive sign for technology integration in the delivery of instruction.

## **CONCLUSION AND RECOMMENDATION**

### **Conclusions**

The following conclusions are drawn from the findings of the study.

1. The Public Elementary School teachers of Tacdian Elementary School, Bahong Elementary School and Don Pulas Elementary School used smart Tv in their instructional delivery. However, they did not use smart classroom and pen scanner.
2. The Public Elementary School teachers of Tacdian Elementary School, Bahong Elementary School, and Don Pulas Elementary School integrate technology in their instructional delivery by using Learning Management System (LMS), educational apps, and podcast and multimedia. Nonetheless, they did not use coding and robotics in the instructional delivery.
3. The Public Elementary School teachers of Tacdian Elementary School, Bahong Elementary School, and Don Pulas Elementary School are not consistency integrated IoT technology in their instructional

delivery, as overall result, teachers “sometimes used” the IoT technology applications, but they often used LMS, educational apps, and podcast and multimedia and they used sometimes the gamification in the teaching learning process. However, they never used coding and robotics.

4. The Public Elementary School teachers of Tacdian Elementary School, Bahong Elementary School, and Don Pulas Elementary School experienced benefits of using IoT technology particularly on learners are engaging in the class but mostly did not perceive the benefit of being convenient and easy to manipulate.
5. The Public Elementary School teachers of Tacdian Elementary School, Bahong Elementary School, and Don Pulas Elementary School faced challenges particularly on new technologies, the internet access of the learners, and they need mentoring or training to fully grasp the use of such tools. Fortunately, internet connectivity issues in the area was not their major challenges.

### Recommendations

Based on the findings and conclusions of the study, the following recommendations are forwarded by the researcher.

1. The school may seek partnerships that support educational technology. They may reach out to individuals who may be willing to donate the equipment.
2. The teachers may utilize free online platforms like Code. Org, Scratch and Khan Academy for coding lessons. They may seek partnerships to provide resources and funding support.
3. Teachers may collaborate with other teachers who have experience with coding and robotics and explore free online resources for teaching coding and robotics.
4. The school may offer workshops and ongoing support for teachers to familiarize them with technology tools and how to effectively manipulate them. Provide step by step guides, tutorials, and troubleshooting resources to improve confidence in using technology. Continuously evaluate the effectiveness of technology solutions and seek feedback from teachers on areas for improvement.
5. The school may provide specific training on how to integrate new technologies into teaching practices effectively. The training may cover instructional strategies, curriculum alignment, pedagogical approaches, assessment and learning outcomes. They may assign technology mentors or instructional coaches to work closely with teachers and provide personalized guidance, support, and feedback on technology integration efforts. Foster a culture of continuous learning and innovation where teachers are encouraged to stay updated with new technologies, trends, and best practices.

### Summary

The survey revealed that teachers Tacdian Elementary School, Bahong Elementary School and Don Pulas Elementary School have integrated IoT technology into their delivery of instruction, however few are using IoT technology extensively. The findings show that a teachers used smart TVs then some teachers used laptops, desktops, and smartphones in their teaching and learning process, but they never used smart classroom and pen scanner.

In the teaching and learning process, teachers used Learning management system, educational apps, and podcast and multimedia but they will not use coding and robotics in their instructional delivery.

However, Overall, teachers used technology in the delivery of instruction occasionally or situationally but in specific area, some teachers often used learning management systems, educational apps, and podcast and multimedia resources and they used gamification frequently, but they never used coding and robotics.

Teachers identified several benefits of IoT technology use particularly on learners are engaging in the class as the greatest benefits they experienced, followed by it makes teaching and learning exciting and learners become proactive and creative. However, teachers perceived less on convenient and easy to manipulate.

In using the IoT technology, the commonly challenges based on the result includes not all teachers are update with new technology, not all learners have access to internet and needs more mentoring or training to fully grasp the use such tools, and internet connectivity issues in the area is not major challenges.

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