Exploring Key Factors Influencing the Willingness of Elementary School Resource Class Teachers to Integrate Technology into Teaching: A Mixed-Methods Approach

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***Abstract*—Amidst the COVID-19 pandemic, there has been an increased demand in the education sector for the integration of information technology in teaching. Special education instruction differs from regular classrooms, as it requires simpler and more easily absorbed methods to facilitate student learning. Using the mixed research methods, this study investigates the key factors that affect the willingness of elementary school resource class teachers to use technology in teaching. The results of the study show that the top three key factors influencing the willingness of elementary school resource class teachers to use technology in teaching are: can improve student motivation to learn, can enhance student understanding, and able to immediately help solve difficulties. This shows that resource class teachers prioritize the benefit to students with special needs when choosing digital technology tools. Additionally, this study provides relevant suggestions that can serve as a reference for future special education professionals in their integration of technology in teaching.**

***Keywords*—digital technologies in education, integrating technology into teaching, special education teacher, resource class, mixed research methods**

I. Introduction

The development of integrating technology into teaching stems from the rapid advancement of modern societal technology and the evolution of educational philosophies. With the widespread adoption of information technology, the internet, and digital tools, the education sector has come to recognize the potential of technology in enhancing learning experiences and instructional effectiveness. This trend reflects the demand for more flexible and personalized learning approaches to address the constantly changing learning environment and the diverse needs of students. Technology integration in education refers to the use of various technologies to enhance the process of learning and teaching. These technologies include the internet, electronic whiteboards, digital learning materials, virtual classrooms, distance learning, and multimedia-assisted teaching tools [1, 2]. The introduction of interactive learning software, online resources, virtual classrooms, and intelligent teaching tools provides students with more engaging, flexible, and personalized learning experiences. During the COVID-19 pandemic, children worldwide began utilizing online learning devices, applications, tools, or procedures to engage in various course activities [3, 4]. Whether educators or learners, individuals, therefore, had increased exposure to digital technology, enhancing their familiarity with it. The benefits of technology integration in education include enhancing student motivation and interest, providing a better learning experience, improving teaching efficiency, breaking geographical barriers, and improving learning outcomes [5].

Technology plays an extremely important role in special education. It can provide more diverse learning methods for students with special needs, help them overcome learning obstacles, and improve their learning achievements. For students who need special education assistance, the process of learning skills may require longer periods of time, individualized instruction, specially designed teaching materials, or repeated practice more than their peers [6]. The U.S. Department of Education identified in the National Education Technology Plan in 2017 that the reason why educational technology is important is that it can provide equal learning opportunities for students [7]. The plan elaborates that technology helps achieve learning equity and accessibility, change students' learning experiences, narrow achievement gaps, and eliminate barriers to learning for students. Educational technology can help teachers meet the individualized needs of special students through engaging them in course content, providing alternative ways to access the curriculum, and supporting differentiated instruction [8, 9]. Digital learning tools adopt the principles of Universal Design for Learning (UDL), which is a method of improving the learning performance of all students by providing multiple ways of engagement, representation, action, and expression [7]. Overall, the importance of technology in special education has been widely recognized by the international community and experts, and the use of technology as a teaching tool and strategy has been proven to bring more learning and participation opportunities for students with special needs.

As technology products and techniques continue to advance, new tools that are suitable for integration into teaching are constantly emerging. However, in the teaching field, the commonly used teaching tools seem to have not changed significantly with the evolution of technology. The main research question of this study is to investigate the reasons why teachers do not choose to use new digital technology tools or are unwilling to integrate technology into their teaching. Therefore, this study aims to elucidate this phenomenon through a literature review, Modified Delphi

Method (MDM) expert interviews, and the application of the Analytic Hierarchy Process (AHP). The results will be presented to special education practitioners as a reference for integrating technology into teaching. Simultaneously, the findings will be provided to policymakers in the field of special education, offering substantial support to ensure an adequate policy framework that supports special education practitioners.

II. Literature Review

In Taiwan, resource classes refer to a category within the special education system, primarily enrolling students with milder degrees of disabilities [10]. Special needs children who attend resource classes have greater individual differences in physical and mental development. Resource class teachers must implement adaptive education that meets individual needs based on the students' physical and mental characteristics. According to relevant studies, incorporating technology into the teaching of special needs students can improve their learning difficulties, enhance their reading, math, language, typing abilities, communication, and effectively improve their lack of concentration. This can also effectively increase their confidence in learning [11–13].

A. Technology Integration in Resource Class Teaching

For resource class teaching, technology integration can increase students' learning motivation, provide more diverse learning methods, promote learning effectiveness, and help students overcome learning barriers. Educational technology often uses Assistive Technology (AT), such as audio books and reading pens [14], and UDL framework, which aims to achieve an accessible learning environment by focusing on the obstacles in the environment rather than the student's physiological obstacles [3]. One study found that AT helps in the development of reading abilities in children with reading disabilities because the use of smartphones and tablets can increase their learning opportunities [15]. Svensson *et al.* [16] also found that the use of AT can improve the abilities and increase the motivation of students with reading disabilities.

In addition to its positive impact on reading ability, many studies have also confirmed that incorporating technology into teaching can help improve the math performance of children with learning disabilities [17–20]. Furthermore, researches by Klimova and Zamborova [21] and Wang *et al.* [22] have indicated that using educational technology in teaching or learning can enhance students' learning motivation.

B. Resource Class Teachers' Willingness to Use Technology to Integrate into Teaching

Resource class teachers use technology integration in teaching with the aim of enhancing students' learning outcomes through the power of technology, making it easier for students to understand and grasp learning content. Additionally, technology can provide diverse learning methods to accommodate different students' learning styles and ability levels. The main reasons for this are as follows [11, 23]:

1) Enhance learning effectiveness: Technology can provide vivid and intuitive learning experiences, such as using videos, interactive exercises, gamified learning, etc., to make it easier for students to grasp and understand learning content. Studies have shown that integrating technology into teaching can improve students' motivation and learning outcomes, especially for students in resource classes.
2) Diversified learning methods: Resource class students have significant differences in learning styles and abilities, so providing diversified learning methods is essential for them. Technology can provide different forms of learning experiences, such as images, audio, and video, allowing students to choose the most suitable way to learn.
3) Providing immediate feedback: Technology-integrated teaching can also provide immediate feedback and assessment, allowing teachers to better understand students' learning situations and progress, and adjust teaching strategies and content in a timely manner.

In summary, if a particular technology or tool can effectively enhance student learning outcomes, provide diverse learning modalities, and offer real-time feedback and assessment to assist students in better grasping the learning content, it can increase the willingness of resource class teachers to integrate technology into their teaching. However, studies indicate that insufficient teacher professional knowledge may impede effective technology assistance for students with special needs [24]. Insufficient professional knowledge may present a significant barrier to technology integration, influencing the ways in which technology is used in the classroom [25]. Yet, it remains unclear how this dynamic operates in special education, and whether special education practitioners encounter distinct barriers to technology integration [26]. Therefore, this study collected recent literature on the integration of technology into teaching, prioritizing more recent publications and focusing on research involving resource class teachers. Emphasis was placed on discussions regarding emerging technologies. The criteria mentioned in the literature were subsequently organized and compiled into Table 1. These criteria were incorporated as assessment factors for the pre-test questionnaire used in the selection of factors.

Table 1. Assessment factors for resource class teachers' willingness to integrate technology into teaching

Authors indicators	A [27]	B [28]	C [5]	D [8]	E [29]	F [26]
Teachers' confidence with using technology	∨	∨	∨	∨	∨	
Teachers' beliefs about technology value	∨	∨		∨	∨	
Teachers' interest towards technology			∨			
Teachers' interest to learn new technologies			∨			
Teachers have time to experiment with new technologies						∨
Students have sufficient hardware skills		∨				∨

Students have sufficient software skills		∨			∨
Students need to use technological tools in the classroom	∨	∨			
Using technology to enhance student understanding	∨				
Using Technology to Improve Student Motivation	∨		∨		
Schools are supportive of the use of educational technology				∨	∨
Schools always purchase new technology tools for teachers to use		∨		∨	
Schools hold teacher training on new technologies					∨
School will continue to organize teacher training					∨
Colleagues share technology usage with each other					∨
When teachers encounter technical difficulties in the classroom, someone can provide immediate technical support	∨			∨	∨

III. Materials and Methods

The purpose of this study is to explore the key factors influencing the willingness of elementary school resource teachers to integrate technology into teaching. Through literature review and MDM, evaluation criteria were established, and AHP was used to conduct questionnaire surveys and analyze relative weights of factors. The research process is shown in Fig. 1.

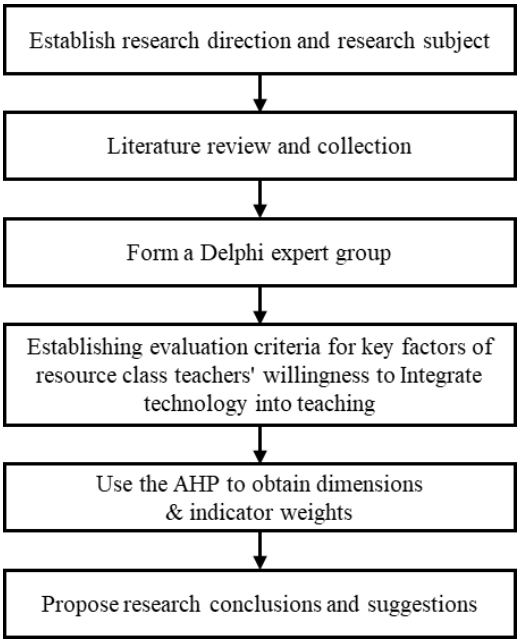

Fig. 1. The research flow chart.

A. Modified Delphi Method

Delphi method is a technique for expert collective decision-making, which is a systematic and quantitative research method for obtaining expert consensus. Researchers ask multiple experts to express their opinions in a verbal or written manner on a particular topic and gradually integrate the group's expert opinions through multiple rounds of opinion exchange, thereby obtaining the final conclusion. The typical Delphi method uses an open-ended questionnaire for the first round of surveys, but Murry and Hammons [30] have revised the steps of the typical Delphi method by using a prototype questionnaire developed through literature review as the first survey, replacing the open-ended questionnaire of the typical Delphi method, which is called the MDM.

Therefore, based on the use of the MDM, which can fully reflect the opinions of various experts, encourage collective wisdom, and has high accuracy, this method is adopted as the indicator evaluation tool for this study, and possible directions for improvement and suggestions are proposed. In terms of operation, because experts' opinions are solicited anonymously, it avoids experts discussing with each other and prevents horizontal connections from occurring, thus preventing expert opinions from being influenced [31].

B. Analytic Hierarchy Process

AHP is a decision-making method developed by Thomas L. Saaty, a professor at the University of Pittsburgh in 1971 [32]. It is mainly used for decision-making problems with multiple evaluation criteria under uncertain conditions. AHP breaks down complex problems systematically and hierarchically, and uses pairwise comparisons to determine the relative importance of elements, to arrange the order of selection, and to provide decision-makers with sufficient information to reduce the risk of decision-making errors. In recent years, educational institutions have gradually adopted the AHP in practical research. Therefore, this study will also use the AHP to objectively quantify the many factors that affect the willingness of resource class teachers to integrate technology into resource class teaching, analyze the relative weights between factors, and divide them into priority order according to their importance. The key factors affecting the willingness of resource class teachers to integrate technology into resource class teaching will be analyzed based on the research results.

C. Participants

The scope of experts participating in the MDM interviews in this study is mainly focused on educational experts and teachers who understand the current situation of special education in Taiwan. According to Brooks [33], the group error is lowest and the reliability is highest when the number of experts participating in the MDM interview is over 10. Delbecq *et al.* [34] suggested that the number of members in a homogeneous expert group should be between 15 and 30, and if the group is heterogeneous, the number should be between 5 and 10. As the expert panel in this study consists exclusively of currently employed teachers, it is characterized by a high level of homogeneity. Therefore, the expert panel is composed of a total of 16 individuals. Analyzing the administrative experience and teaching seniority of the expert group can enhance the reliability of the

study sample. Among the interviewees, 2 people (12.5%) have been in their profession for 6–10 years, 2 people (12.5%) for 11–15 years, 6 people (37.5%) for 16–20 years, and 6 people (37.5%) for over 20 years.

The subjects who participated in the AHP questionnaire in this study were mainly current resource class teachers in elementary schools. There were 4 teachers (21.1%) with teaching experience of less than 5 years, 2 teachers (10.5%) with 6–10 years of experience, 3 teachers (15.8%) with 11–15 years of experience, 5 teachers (26.3%) with 16–20 years of experience, and 5 teachers (26.3%) with more than 20 years of experience, for a total of 19 participants.

D. Construction of Key Factors Model for Resource Teachers' Willingness to Integrate Technology into Resource Class Instruction

1) Pilot questionnaire for evaluation criteria: based on the comprehensive literature review of the criteria for willingness to integrate technology into teaching (Table 1), all the criteria mentioned in past literature were included as evaluation factors and integrated into three major criteria and sixteen sub-criteria. The pilot questionnaire was designed using the modified Delphi method and administered to education experts and teachers who are familiar with the current situation of special education. According to the convergence criteria proposed by Holden and Wedman [35]: "When more than 85% of the items achieve consensus, it indicates that the opinions of the research experts have reached unanimity." After two rounds of expert questionnaires and feedback, the items with a standard deviation greater than 1 were removed, and the evaluation factors with an importance rating of 4 or higher on the average were selected. Finally, three major criteria and fourteen sub-criteria were identified (Fig. 2).
2) Design an AHP questionnaire based on the pre-test questionnaire results to make pairwise comparisons for each criterion. The selection of evaluation factors in this study has avoided inconsistency or incorrect correlation among the factors to enhance the accuracy of the AHP results. The explanations of each hierarchical factor in this study are shown in Table 2.

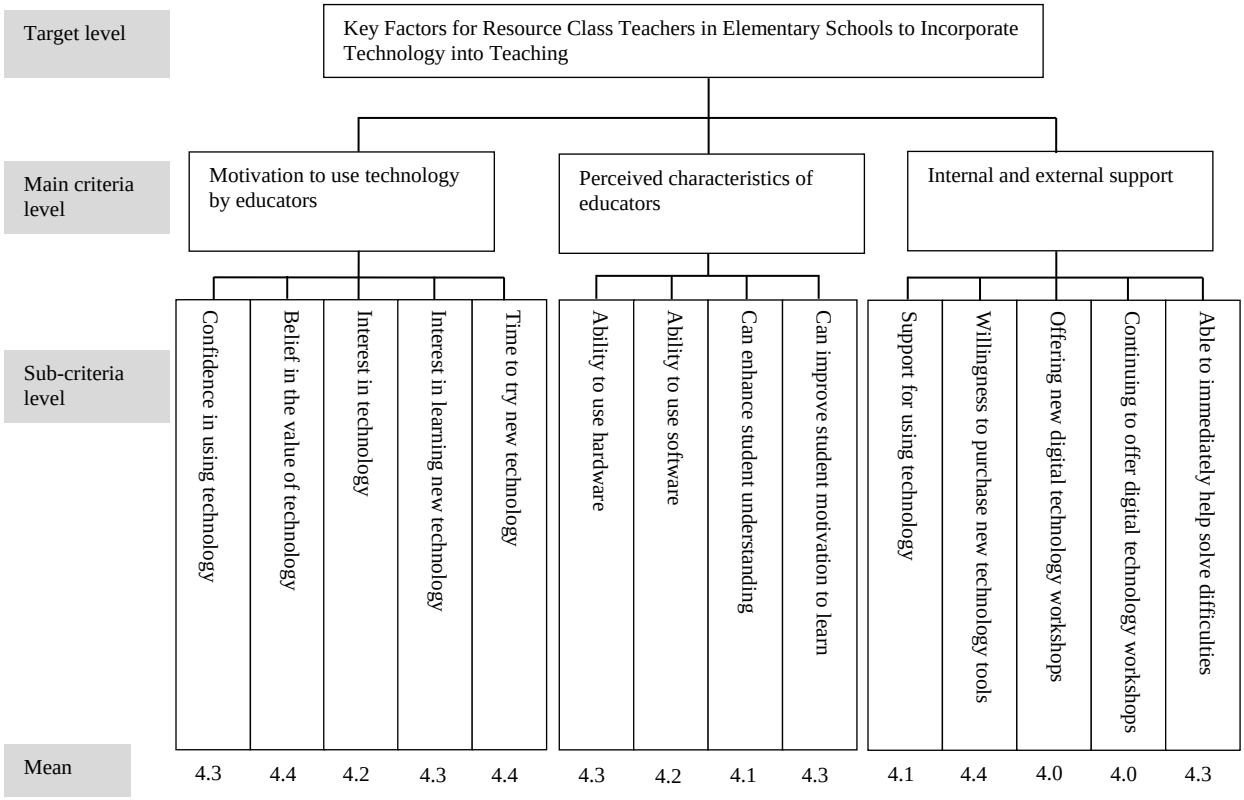

Fig. 2. Hierarchical structure diagram.

Table 2. Explanation table of evaluation criteria for resource teachers' willingness to use technology in teaching integration

Dimensions	Indicators	Explanation
Motivation to use technology by educators	Confidence in using technology	Teachers have confidence in their ability to use digital technology in teaching.
	Belief in the value of technology	Teachers believe in the value of digital technology for teaching.
	Interest in technology	Teachers have interest in digital technology.
	Interest in learning new technology	Teachers have interest in learning new digital technology.
	Time to try new technology	Teachers have time to try new digital technology.
Perceived characteristics	Ability to use hardware	Teachers believe students have sufficient ability to use digital technology hardware.

of educators	Ability to use software	Teachers believe students have sufficient ability to use digital technology software.
	Can enhance student understanding	Teachers believe using digital technology in teaching can enhance student understanding.
	Can improve student motivation to learn	Teachers believe using digital technology in teaching can improve student motivation to learn.
Internal and external support	Support for using technology	Schools support teachers using digital technology in teaching.
	Willingness to purchase new technology tools	Schools proactively purchase new digital technology tools for teachers to use.
	Offering new digital technology workshops	Schools offer new digital technology workshop training.
	Continuing to offer digital technology workshops	Schools continue to offer digital technology workshop training.
	Able to immediately help solve difficulties	When teachers encounter difficulties using digital technology in the classroom, someone at the school can immediately provide assistance.

Source: author's comprehensive collation.

IV. Result and Discussion

The consistency of the AHP questionnaire results is determined by using the Consistency Index (C.I.) and Consistency Ratio (C.R.) to test the consistency of pairwise comparison matrices [32]. When C.I. = 0, it indicates complete consistency in the judgments made before and after, whereas C.I. > 0 indicates inconsistency, and C.I. < 0.1 is an acceptable level of bias. When C.R. < 0.1, the consistency of the matrix is considered satisfactory. Finally, all the comparison scores provided by the respondents are aggregated using the geometric mean to determine the relative weights between criteria at each level, in order to determine the comprehensive evaluation scores of each sub-criterion and identify the relative importance of criteria. The C.I. and C.R. of the results of this study are both < 0.1, indicating good consistency.

As shown in Table 3, among the three main criteria, the results indicate that the motivation of the teacher has the greatest impact, and when considering whether to integrate technology into teaching, resource class teachers mostly prioritize the influence of their own factors before deciding whether to use digital technology tools.

Table 3. The integration weights of evaluation dimensions and evaluation indicators

Evaluation Dimensions	Weight (A)	Evaluation indicator	Weight (B)	Integration weight (C) = (A)*(B)
Motivation to use technology by educators	0.369	Confidence in using technology	0.183	0.068
		Belief in the value of technology	0.158	0.058
		Interest in technology	0.201	0.074
		Interest in learning new technology	0.227	0.084
		Time to try new technology	0.232	0.086
Perceived characteristics of educators	0.331	Ability to use hardware	0.167	0.055
		Ability to use software	0.228	0.075
		Can enhance student understanding	0.291	0.096
		Can improve student motivation to learn	0.314	0.104
Internal and external support	0.300	Support for using technology	0.150	0.045
		Willingness to purchase new technology tools	0.198	0.059
		Offering new digital technology workshops	0.169	0.051
		Continuing to offer digital technology workshops	0.170	0.051
		Able to immediately help solve difficulties	0.314	0.094

Note: the parentheses after the weight number mean the ranking.

Regarding the secondary criteria at various levels, the top three with the highest weightings are "can improve student motivation to learn", "can enhance student understanding", and "able to immediately help solve difficulties". This shows that resource class teachers prioritize the benefit to students with special needs when choosing digital technology tools. If there are dedicated personnel to assist resource class teachers with any issues related to tool usage, this can further enhance their willingness to incorporate technology into their teaching. Conversely, the bottom three in terms of weighting are "support for using technology", "offering new digital technology workshops", and "continuing to offer digital technology workshops". This indicates that the school's attitude and support have the least impact on resource class teachers. Although it is beneficial for resource class teachers to regularly participate in professional development courses and training to understand the latest technology trends and teaching strategies, and continuously improve their teaching skills and knowledge, the use of digital technology tools as a teaching method is not a necessary choice given the independent nature of their teaching content and the differences in teaching activities due to individual differences among students.

Based on the AHP questionnaire data, it was found that among the three main criteria, "motivation to use technology by educators" was the most significant indicator, followed by "perceived characteristics of educators", and lastly, "internal and external support." Among the 14 evaluation factors of the secondary criteria, "can improve student motivation to learn", "can enhance student understanding", "able to immediately help solve difficulties", "time to try new technology", and "interest in learning new technology" were the most significant influencing factors. The top five factors include four that are encompassed within the main criteria of "Instructor Motivation" and "Perceived Characteristics of Instructors," thereby validating the questionnaire results related to the primary criteria. This also signifies that

teachers' positive beliefs about technology can assist them in overcoming barriers to use [25].

Finally, "support for using technology", "offering new digital technology workshops", and "continuing to offer digital technology workshops" were among the lowest-ranking factors in the overall weight. By examining the factors with higher comparative rankings, it is evident that resource class teachers integrate technology into teaching with the aim of enhancing student learning outcomes, diversifying learning approaches, and providing various forms of learning experiences through information technology [11, 23]. This result aligns with findings in previous literature, indicating that the assessment of teachers' willingness to use technology is more closely associated with individual motivations and student factors, with less impact from internal and external influences.

Based on the findings of this study, the following recommendations are proposed for the reference of relevant educational entities. Firstly, the design of information technology tools should align with the needs of resource class teachers and students, enhancing the acceptance of these tools by combining enjoyment with learning to effectively engage students [36]. Secondly, it is suggested to strengthen the user experience (UX) of resource class teachers with information technology tools, addressing psychological needs and fostering a positive perception of utility and usability. This can encourage resource class teachers to adopt information technology tools willingly [37].

V. Conclusion

This study investigates the key factors that affect the willingness of elementary school resource class teachers to use technology in teaching by using the mixed research methods. Our research findings indicate that resource class teachers prioritize students' interests and the enhancement of learning outcomes when incorporating technology into teaching. We hope that the results of this study will encourage resource class teachers and assist them in more successfully and effectively integrating technology into their teaching practices. Additionally, we hope that government-related entities can provide support to resource class teachers, fostering positive beliefs and making them more willing to explore new technologies or techniques.

The present study employed the MDM and AHP for investigation. The selection criteria for the expert panel were not predetermined, and the study generated the list of interviewees based on expert recommendations. However, the confirmation of whether there are omissions in this list remains unverified, constituting one of the limitations of the study. The chosen participants for the study were predominantly frontline teachers, and administrative officials responsible for policy-making were not included, representing a second limitation. It is suggested that future researchers incorporate relevant personnel from educational institutions to obtain research results from diverse perspectives. In the future directions of research, it is recommended to first categorize the explored digital technology tools. Given technological advancements, there are numerous digital technology tools available for selection, and resource class teachers excel in using different tools. It is suggested that future studies delve deeper into understanding the utilization patterns and willingness of resource class teachers towards different types of digital technology tools or focus on exploring specific tools. Secondly, there are many types of special needs students, and most resource teachers come into contact with students with learning disabilities. Their acceptance of different digital technology tools also varies. It is suggested that in the future, research can be conducted on students with different learning disabilities to understand their higher acceptance of certain digital technology tools. This can attract resource teachers to use these tools to integrate into their teaching, thereby enhancing students' learning motivation and interest.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Conceptualization: L.M.C., and H.H.L.; Methodology: L.M.C., and H.H.L.; Validation: H.H.L., and Y.C.C.; Formal Analysis: H.H.L., and Y.C.C.; Original Draft Preparation: H.H.L., and Y.C.C.; Writing Review and Editing: L.M.C., and H.H.L. All authors had approved the final version.

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