The teacher’s competence of integrated teaching at primary school science

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Abstract. The paper presents some research results on primary teachers’ competence on integrated teaching in Vietnam. We have conducted a survey with teachers and educational managers in the context of renewing general education curriculum and textbooks as well as new teacher’s professional standards. The research results have shown that most of respondents agreed with our proposed competencies for integrating teaching and their basic components. Based on these components, we have described indicators for each capacity and suggested some measures to design continuous professional development for primary teachers so that they could meet the requirements of general education renovation.

1. Introduction

Integrated teaching is an orientation in education reform, a radical change from content-based teaching approach to competency-based approach in order to train dynamic and creative people who are capable of applying knowledge when solving problems in real life. Integration is an approach to teaching and learning based on a variety of fields, sectors and practice. It involves the acquisition of knowledge, skills, attitudes and values within or outside the subjects to develop a stronger understanding of crucial ideas. Integration occurs when components of the curriculum are linked and related in meaningful ways by students, teachers, specialists... accordingly, many of the areas or topics of the subject are linked together. Integration is not a new way to organize teaching at the primary school. Educators first explored the notion of integrated curriculum in the 1890s. Over the years, there have been many educational researchers, such as Susan Drake, Heidi Hayes Jacobs, James Beane and Gordon Vars, who have described different understandings of the integrated curriculum, referring to interwoven, connected, thematic, multi-disciplinary, related, linked and holistic curricula. Some educators, such as Robin Fogarty, go beyond a single definition of integrated curriculum and consider it as a continuum. How does the term “integration” show its relation and linking between subjects in the curriculum, especially the topics of the school program in general and primary school program in particular [1,6,13].

Integration in teaching is a trend of modern teaching approach, but now in Vietnam it is not widely applied in schools. Integrated teaching is the suitable orientation and a means by which students can develop deep knowledge structures that are connected with one another. However, there is no consensus on the definition of integrated teaching. Some researchers have argued that explicit definition is very difficult, so many terms are often used to indicate this coordination [2,8,3]. These
research have showed that integrated teaching helps students shape competencies including the ability to apply knowledge to solve problems, especially the use of knowledge in practice because problems arising in life. Business are rarely related to a certain field of knowledge but usually require the integrated application of knowledge in a number of different disciplines. This is to say that primary education must help students have an overview of the world in its inherent complexity, not divided into disciplines or sectors too early.

In order to have an integrated teaching result as expected, teachers are required to have suitable integrated teaching competencies. Therefore, in this research, we have explored and identified the characteristics of integrated teaching and some basic components of integrated teaching competence for primary teachers in Vietnam.

2. Literature Review

We examined the primary teacher competency framework of some countries in the world. This international experiences suggest us to propose teaching competencies for primary teachers in my country.

*Columbia and British Primary School Teacher Profiles*

Colombia primary school teacher profiles include three areas: knowledge, skills, values and attitudes. For the knowledge, they refer to curriculum, teaching content, pedagogical profession, theoretical teaching and updating knowledge of contemporary society. For the skills, they refer to practice, emotion, pedagogical skills, life skills, management skills, research and reflection skills, social skills, cooperation and teamwork skills, communication skills. For the values and attitudes, they refer to personal qualities and ethics, ethics and professional responsibility.

British primary school teacher profiles include two areas: teaching capacity; qualities, personal and professional ethics.

*Australian Primary School Teacher Profiles*

Australian primary school teacher profiles include the following basic components: Understanding of students and how they learn; understanding of the teaching content and how it is taught; plan and implement effective teaching activities; establish and operate a safe, friendly teaching environment; evaluate, give feedback and report the results of the evaluation of the learning process; practice and improve professional skills; promote effective relationships with colleagues, parents and other educational stakeholders.

Thus, in comparison with the primary teacher competency framework of some countries in the world, it is generally recognized that the capacity of primary teachers is focused on three main areas such as: Political qualities, ethics, lifestyle; knowledge; pedagogical skills.

*Characteristics of Integrated Teaching at Primary Schools*

Primary school is the first level of the education system that provides basic and life-long education for children who continue to study at the continuous levels, helping children to form initial foundations of personality. Thus, primary education has special pedagogical characteristics, with its own nature. In integrated teaching, it was found that teaching content is related to concepts in a way that is not bound by the boundaries of particular disciplines.

We can see more clearly about the characteristics of integrated learning through a number of studies by many authors describing its requirements. Brown describes integrated teaching in four main characteristics [2]: (i) the unity of all knowledge that integrated science has a holistic view of basic knowledge as a whole; (ii) the conceptual unity of science that make up the defined frameworks; (iii) the unified scientific process emphasizes the distinction between methodological and scientific disciplines; (iv) in integrated teaching, a problem can be solved in many areas of coordination.

In general, the purpose of integrated teaching at primary schools is to shape and develop students’ abilities, enable the students to apply mathematical knowledge and related fields to solve real life
problems. The core of competence is the ability of the subject to combine the knowledge, skills with attitudes, values, motives in a flexible way in order to meet the complex requirements of an activity and ensuring that the activity is successful in a certain teaching context.

3. Research Results and Discussion

The research aims at finding the basic competency components of teachers for integrated teaching at primary schools. This research has used cross-sectional surveys. The sample consisted of 80 primary school teachers, 20 educational administrators at some primary schools in 4 provinces in Vietnam. The research tool includes a structured questionnaire with 100 copies released and 97 copies collected with full responses. After conducting the survey, we have compiled the answers, calculated the percentage for each question in the questionnaire. From the data collected, we have analyzed and evaluated the necessary level of components of integrated teaching competence, then suggested the teacher’s components in integrated teaching that should be trained at the teacher training institutions.

In order to identify the basic components of the integrated teaching competence of primary school teachers, as well as to explore the need for developing and fostering those components, we considered the following scientific bases: (i) a theoretical study of the teacher competence framework; (ii) international studies of integrated teaching competence; (iii) new school curriculum and teachers’ professional standards.

In addition, we have conducted a survey of 97 teachers and educational managers at some primary schools. The research results have shown that teachers and educational managers are interested in the components of integrated teaching (see Table 1).

Table 1. The necessity of competency components for integrated teaching

| Basic components                              | Very necessary (%) | Necessary (%) | Normal (%) | Unnecessary (%) |
|-----------------------------------------------|--------------------|---------------|------------|----------------|
| Capacity to define teaching objectives        | 52.58              | 32.99         | 11.34      | 3.09           |
| Capacity to plan integrated teaching         | 48.45              | 39.18         | 9.28       | 3.09           |
| Capacity to design integrated teaching lessons| 63.92              | 35.05         | 1.03       | 0.00           |
| Language competence in integrated teaching   | 46.39              | 48.45         | 5.15       | 0.00           |
| Capacity to cooperate in integrated teaching | 39.18              | 34.02         | 19.59      | 7.22           |
| Capacity to design and create an integrated teaching environment | 47.42              | 42.27         | 10.31      | 0.00           |
| Capacity to connect lesson content and practice | 45.36              | 46.39         | 8.25       | 0.00           |
| Capacity to organize integrated teaching     | 52.58              | 43.30         | 4.12       | 0.00           |
| Capacity to evaluate students’ learning outcomes | 51.55              | 39.18         | 8.25       | 1.03           |

Through the survey, more than 52% respondents said that the ability to determine the objectives of a lesson was very necessary. Identifying instructional goals for integrated teaching is important because it involves the contents, the objects, the objectives to be achieved, and finally the integrated learning outcomes of students. Only 11% of the respondents considered it as normal. This was because, when the research team distributed the questionnaires to elderly teachers in remote areas,
they did not accept modern teaching methods. More specifically, they said that, due to retirement, there was not much motivation for them to change the form of teaching, however, they also acknowledged that the change in the direction of modernity is better. Meanwhile, only 3% of respondents did not care about the teaching objectives. Nearly 49% respondents said that integrated teaching planning capacity was very necessary. Only about 9% was normal and 3% unnecessary. Thus, we have found that teachers and educational managers appreciated the need for a fully integrated teaching plan.

From Table 1, it could be seen that most teachers and educational managers are very interested in the basic components (e.g., integrated teaching design; language competence in integrated teaching; cooperative capacity in integrated teaching; design and create an integrated teaching environment; connect lesson content and practice; organize integrated teaching; evaluate students’ learning outcomes) and would like to have continuous professional development courses for fostering these competencies.

We have examined the teachers’ need for developing and fostering the competency components for integrated teaching. Table 2 showed that most of the primary schools and teachers urgently had demands for teacher training so that they had the capacity for effective integrated teaching.

| Table 2. Primary teacher’s need for integrated teaching competencies |
|---------------------------------------------------------------|
| Contents                                      | Very necessary (%) | Necessary (%) | Normal (%) | Unnecessary (%) |
| Capacity to define teaching objectives          | 44.33              | 30.93         | 21.65      | 3.09           |
| Capacity to plan integrated teaching           | 39.18              | 36.08         | 20.62      | 4.12           |
| Capacity to design integrated teaching lessons | 76.29              | 22.68         | 1.03       | 0.00           |
| Language competence in integrated teaching     | 42.27              | 48.45         | 9.28       | 0.00           |
| Capacity to cooperate in integrated teaching   | 38.14              | 31.96         | 23.71      | 6.19           |
| Capacity to design and create an integrated teaching environment | 50.52              | 34.02         | 15.46      | 0.00           |
| Capacity to connect lesson content and practice| 48.45              | 46.39         | 4.12       | 1.03           |
| Capacity to organize integrated teaching       | 49.48              | 43.30         | 7.22       | 0.00           |
| Capacity to evaluate learning outcomes         | 51.55              | 39.18         | 9.28       | 0.00           |

Table 2. showed that the proportion of the need for the basic components at the level of very necessary and necessary was 70%. In particular, over 98% of teachers and educational managers considered it very important to train the capacity to design integrated teaching lessons. However, in some schools, where the socio-economy is still low, investments in education reform are still difficult, some teachers do not pay much attention to integrated teaching methods.

The teachers’ need for capacity building in integrated teaching at primary schools is urgent. This is a task that contributes to improving the quality of primary education towards a modern, appropriate education in the 21st century.
3.1 Capacity to Define Teaching Objectives
Identifying the lesson objectives is based on the knowledge, skills and requirements of the program. This step is set by defining the goal of the lesson as an indispensable role in each lesson plan. The goal (requirement) is both the destination and the need for learning; in other words, it is the measurement for the result of teaching process. It helps teachers identify what tasks they will have to do (instruct students to learn, apply knowledge, skills, scope and extent, and then withdraw lessons to learn).

When defining instructional goals, teachers must point out the process in which students can find, identify, occupy, and develop knowledge, skills, and attitudes. That is, point out the way students think to achieve those results. For example, with the topic “measure the length of straight line” in Math Grade 1, the goal that teachers expect students to achieve is: Students have understandings of “shorter, longer”, using the things that are around them as a tool to help with their measurement. Students can then measure length in practice (which can be done by hand, foot, arm, etc.). Thus, in order to set appropriate teaching objectives, teachers need to have the capacity to define teaching goals.

3.2 Capacity to Plan Integrated Teaching
Effective lesson planning requires time, dedication, and understanding of student abilities and goals. In primary education, every teacher tries to encourage students to acquire knowledge as much as possible during class and apply it. The teacher performs the lesson as stated in the plan to achieve the goal of the course. Measuring a successful lesson plan is often proven through the use of a board, homework, or test.

To plan a lesson is to know your students, understand who the teacher is going to educate and predict different students’ learning styles (visual, auditory, tactile, or combination, etc.). Teachers adjust their lesson plans to incorporate all learning styles through independent and group exercises. If teachers are familiar with student group learning, teachers may choose to plan ahead to increase interaction. The lesson plan should be specific to the activities, the content of the learning, the role of the participants, etc. In order to have a fully integrated teaching plan, the teacher should have the capacity for the task.

3.3 Capacity to Design Integrated Teaching Lessons
The teacher’s preparation for a teaching hour is often reflected in the preparation of the lesson plan. This is the activity of developing plan for a specific lesson, demonstrating the interaction between teacher with students, students with students in order to achieve the objectives of the lesson. Based on the syllabus, both teachers’ professional qualifications and pedagogical skills can be assessed, reflecting their perceptions of educational issues such as educational objectives, how to use teaching methods, teaching aids, forms of teaching organization, and how to evaluate students’ learning outcomes in relation to relatively stable factors like: plan, time, facilities and target students. Therefore, the preparation for one teaching hour has a decisive role and significance to the quality and efficiency of teaching hour.

For students to have good academic results, teachers need to have good lesson plan design, which is only possible when the teacher is competent to integrated teaching design.

3.4 Language Competence in Integrated Teaching
Language competence is a broad term that includes linguistic or grammatical ability, presentation capacity, social or cultural linguistics capacity and what can be termed literary competence. Language competence refers to language knowledge and the ability to use that knowledge to interpret and produce meaningful texts appropriate to the situation in which they are used. Language competence is best developed in the context of activities or tasks where language is used for practical purposes, in other words, in practical applications.

Taking a holistic approach means educating a child as a whole, and taking all aspects of development into consideration. It is to gather every aspect of the individual, emotional, cognitive,
social, and linguistic development in an integrated way. Teachers with good language ability can help students to transform real world problems with mathematics and vice versa. Integrated teaching aims at applying many skills, especially STEM skills, so the language skills of teachers are very necessary.

3.5 Capacity to Cooperate in Integrated Teaching
John Dewey, a pragmatic American educator, was considered the first person to initiate a cooperative teaching trend in the early 1900s. Previously, the concept of education was the transmission of ideas and experience, or an enlightening process that helped people effectively use their knowledge. John Dewey always emphasized the role of education and considered education as a means of teaching people how to live cooperatively in a democratic society.

Some researchers argued that collaborative learning is a structured, systematic, instructional strategy that is implemented together in small groups to achieve common tasks. Collaborative learning is the whole learning activity that students perform together in groups, within or outside the classroom [4,6,12].

The learning environment should be designed to promote active learning and teaching, teaching in classroom, individuals, small groups, and whole group learning. Integrated learning is an example of a teaching arrangement that can be used to motivate students to learn positively, which is an important aspect of learning mathematics and is validated by mathematics educators and researchers. In integrated teaching activities, students may be given the task of discussing, solving problems, and undertaking collaborative learning activities that can be used to supplement instruction by providing students the opportunity to practice newly introduced skills or review skills and concepts. Teachers can use cooperative activities with other teachers or scientists to help them integrate contents that are not their strengths to help students make the connection between math content and other related fields carefully, reaching the required goal. Therefore, teachers need to have the capacity to cooperate in the integrated teaching process.

3.6 Capacity to Design and Create an Integrated Teaching Environment
Teachers need to have a clear idea of the topics they are integrating so that they can point out and explain the connection to learners and encourage them to link together. For example, while buying food we may ask for the price of something; buy it if we can afford it, but decide not to buy it because it does not fit the culture; therefore, language, mathematics and cultural studies skills are integrated and applied in this situation. In addition, after school, learning often takes place in a context and is associated with other languages that are part of our lives. For example, we could read about a special offer, using the internet, a phone or asking a friend to learn more about it, using what we know to compare it with other offers and make decision if we want to the offer. Teachers help students use different skills to learn and place education in context.

Although timetables and time distribution for each topic need to be included in the schedule in a flexible manner, teaching and learning at primary schools sometimes cannot follow a rigid schedule. For instance, it does not allow learner-centered approaches or integrate teaching in education. Therefore, designing and creating an environment for integrated learning is very important. In order to have an integrated teaching environment consistent with the lesson content, students’ psychology and in accordance with general education objectives and subject objectives, teacher needs to be competent for this task.

3.7 Capacity to Connect Lesson Content and Practice
In integrated teaching, choosing meaningful connections between subjects will help students develop upon their diverse knowledge and experience on a topic. This provides the students with a comprehensive view of the world and makes learning more meaningful.

When teaching is organized in a holistic way, it is a better reflection of the real world and learning path at home and in the community. It puts learning in context and allows students to see the scene and make it easier to learn and memorize information. The integrated curriculum allows students to
develop a unified view of the curriculum and extend their learning context beyond the single subject area. It also allows the transfer of learning from one area of knowledge to another. Through integrating the curriculum, teachers can plan the development of important skills and knowledge that transcend the content and subject of the course. Students may also work with many sources of information. Thus, connecting the content of the lesson with practice needs the role of teacher, who helps students approach problems with the knowledge of the subject.

3.8 Capacity to Organize Integrated Teaching

As mentioned above, the integrated teaching process includes the learning activities of students inside and outside the classroom, at home and in the community. Classroom instruction is primarily for activities aimed at identifying issues, proposing solutions to problems, developing problem solving plans, presenting reports, and discussing the outcomes of the problem solving process. The process of learning and research outside the classroom should be monitored and supported regularly to ensure success and effectiveness. Therefore, the organizing integrated teaching topics need to strengthen the application of information technology to perform that function of the teacher.

3.9 Capacity to Evaluate Learning Outcomes

Assessment is a continuous process of teaching and learning to determine what learners can do in areas where they need improvement and whether learning objectives have been met. It is a tool that measures the knowledge and skills of learners and shows where they have weaknesses and strengths. Assessment is also important in giving feedback to parents and is used to change teaching methods, ensuring that all learners have the best chance of acquisition. Also, it is associated with self-evaluation of teachers for their teaching and the methods used. Thus, in order to assess the learning outcomes of students in the integrated learning process, teacher needs to be competent to perform this function.

Based on the above research results, we have also found and determined that the primary school teacher competencies for integrated teaching include two crucial following areas: (i) professional knowledge and understanding; (ii) professional skills and practice.

For professional knowledge and understanding, it includes the knowledge to teach different ages, the different stages and appropriate contents. It is also necessary to understand how students learn and how they can be taught effectively in the major learning areas. The basis for all competency standards is the knowledge of the primary education program. Table 3 below describes in details minimum requirements and indicators for teachers’ professional knowledge and understanding.

Table 3. Indicators for professional knowledge and understanding

| Minimum requirements | Indicators |
|----------------------|------------|
| **Qualification A1: Know how students learn** | - Give examples of student perceptions, psychological, social, emotional and moral development that can affect their learning. |
| A1.1. Demonstrate an understanding of how students learn related to their ages. | - Prepare integrated learning activities that are consistent with the student's level of cognitive, linguistic, social, emotional and physical development. |
Table 3 (Cont’)

| Minimum requirements                                                                 | Indicators                                                                                           |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| A1.2. Demonstrate an understanding of the different ways in which integrated teaching  | - Identify different teaching methods to help different students (gender, ethnicity, culture) have a  |
|   methods can meet the individual learning needs of students.                         |   better and specific learning needs.                                                                 |
|                                                                                        | - Prepare integrated learning activities, explain and support students to link new concepts with their |
|                                                                                        |   prior knowledge and experience.                                                                     |

Qualification A2: Know how to use information technology for integrated teaching

A2.1. Demonstrate an understanding of a wide range of teaching strategies, and resources.

- Make plan and provide opportunities for learning; student interactions, investigations, problem solving, and creativity.
- Use teaching methods, strategies, and materials as required in textbooks and additional low-cost materials to support students’ learning.

A2.2. Demonstrate appropriate use of information and communication technologies (ICT) in integrated teaching and learning.

- Describe the strategy to support responsible, safe and relevant use of information technology for integrated teaching and learning, including at school or personal use.

Qualification A3: Know how to communicate well with students and their families

A3.1. Demonstrate understanding of the role, and expected tasks of primary school teachers.

- Describe the role and duties of teachers in accordance with the standards of the Ministry of Education and Training, accepted by society.

A3.2. Demonstrate an understanding of the social, linguistic and cultural diversity of students and their communities.

- Identify the social culture of students, parents, community elders, and educational administrators when interacting with them during integrated teaching.
- Give examples of strategies to assist all students and participate in integrated learning activities in classroom.

Qualification A4: Know about the curriculum

A4.1. Demonstrate an understanding of the structure, content and expected outcomes of primary education programs.

- Describe the key concepts, content, learning objectives, and outcomes of the core curriculum for target learners.
- Prepare lesson plans that reflect the requirements of the curriculum and include relevant integrated teaching and learning materials and activities.
- Describe the assessment principles that underpin the core curriculum.
Table 3 (Cont’)

| Minimum requirements | Indicators |
|----------------------|------------|
| **Qualification A5: Know the content integrated topics** |
| **A5.1.** Demonstrate understanding of issues to be taught in integrated subjects in classroom. | - Describe key concepts, skills, techniques and applications for the subjects mentioned in classes.  
- Give correct and appropriate information in each lesson, examples and exercises to assist students in learning core content and developing skills.  
- Describe the methods used to promote integrated learning in the core areas: mathematics, science, social studies for classroom and link to the real life. |
| **A5.2.** Demonstrate understanding of how content is conveyed depending on the student’s response, needs, and learning context. | - Describe how to integrate the learning context in terms of age, language, ability, and culture for students to develop understanding of issues related to principles, ideas, and concepts.  
- Explain how lessons are contextual and give examples relate to content, concepts and topics.  
- Describe the approach to develop student fluency in reading and doing mathematics. |

For professional skills and practice, we described what teachers can do, the knowledge and expertise of teacher, teaching strategies for different educational contexts to meet the needs of each student. Table 4 below describes in details minimum requirements and indicators for teachers’ professional skills and practice.

Table 4. Indicators for professional skills and practice

| Minimum requirements | Indicators |
|----------------------|------------|
| **Qualification B1: Coordinate various approaches in integrated curriculum** |
| **B1.1.** Demonstrate the ability to teach programs related to concept and topic content. | - Explain clearly the content of the curriculum and the expected learning outcomes.  
- Choose the guide to link learning with previous knowledge of students, concerns, daily life and local needs.  
- Help students be aware of their ideas to build new understanding. |
| **B1.2.** Ability to apply different strategies in integrated teaching and learning. | - Use appropriate strategies for integrated teaching and learning in classroom.  
- Use mathematics to support students learning in different areas of expertise.  
- Provide opportunities for students to investigate into subjects of related content and concepts through practical activities. |
### Table 4. (Cont’)

| Minimum requirements | Indicators |
|-----------------------|------------|
| B1.3. Demonstrate a well-integrated lesson plan and preparation that fits the students’ learning and experience. | - Plan and structure the lessons to ensure that all lessons are used effectively.  
- Provide and introduce lessons to link new learning content with previous knowledge, to attract students’ interest and encourage them to learn.  
- Prepare teaching experience, continually integrate learning areas and be enthusiastic with the interests and experience of students.  
- Use techniques and interrogative examples to introduce and illustrate acquired concepts. |

**Qualification B2: Assessing, monitoring and reporting students’ learning results**

| B2.1. Ability to keep track of students’ progress and evaluate their learning results. | - Plan and use tasks to assess, integrate with learning activities.  
- Use assessment to enable students to demonstrate achievement in a variety of ways.  
- Use questions and discussion techniques to test students, and provide feedback. |
| B2.2. Ability to record, evaluate and use assessment information to guide the learning process of students. | - Record students’ progress in a consistent and accurate way.  
- Use different validations to track student progress and report the next plan of the curriculum.  
- Talk about the learning progress and achievement to students, parents, and other educators. |

**Qualification B3: Create a supportive learning environment for students**

| B3.1. Ability to create a safe and effective learning environment for all students. | - Use classroom space, materials and resources to ensure the participation of all students in integrated learning.  
- Encourage students to interact with each other and work independently and in groups. |
| B3.2. Demonstrate strategies for managing student behavior. | - Encourage students to interact with each other with respect and safety.  
- Learn about the needs of each student and interact regularly with all students.  
- Encourage the well-adjusted behaviors of students by working in collaborative and independent learning groups. |

**Qualification B4: Work with teachers, parents and the community**

| B4.1. Demonstrate strategies to work with other teachers, parents and local communities to improve the integrated learning environment for students. | - Talk positively to parents about academic culture and curriculum to promote their understandings.  
- Describe strategies to encourage parents to engage in their children's learning at school, at home and in the community.  
- Consider colleagues' perspectives in an effort to cope with learning problems and to accept feedback positively. |
4. Conclusion

Based on the research results, we can conclude that the proposed components for teachers at primary schools are in line with the orientation of Vietnam’s general education renovation and the goal of evaluating primary teachers’ competencies in the 21st century. These teachers’ competencies and their basic components for integrated teaching would provide a teacher competency profiles for training curriculum framework as well as for continuous professional development curriculum framework at the teacher training universities and colleges. Additionally, the research results have also confirmed that primary teachers need to update and foster new knowledge and skills for meeting the demands of general education reform in Vietnam. In this research, we have also identified professional knowledge, professional skills and practice for primary teachers so that they could develop their professional competencies on their own and even by participating some online courses.

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