SPIRAL PROGRESSION APPROACH: DIGITAL LITERACY AND COMPETENCY IN TEACHING SCIENCE

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ABSTRACT

The COVID-19 pandemic has created unprecedented obstacles for teachers, forcing them to adjust to teaching online. Alternative forms of education were the only way to keep teaching and learning going. Teachers were had to adapt to online teaching, which required them to use a variety of digital tools and resources to address problems and adopt new teaching and learning strategies.
The study was conducted in Butuan City, Philippines among the 80 Science teachers of Secondary public schools. It utilized a descriptive-correlational design. Results showed that science teachers are confident in gathering data through digital technologies. The level of digital literacy is high and are competent in finding, understanding, using, and creating digital information. The Spiral Progression Approach implementation of the secondary Science teachers is very high. There is a significant relationship between the level of digital literacy in Spiral Progression Approach implementation. This study recommend that teachers must be knowledgeable about where and when to use technology for teaching and other related duties. Professional development for teachers is critical to the successful integration of computers in classroom instruction. It is thus suggested that teachers receive training to help them improve their computer skills and understanding. Teachers are expected to utilize technology appropriately.

Keywords: COVID-19, pandemic, digital literacy, spiral progression approach

1. INTRODUCTION

The COVID-19 pandemic has created unprecedented obstacles for teachers, forcing them to adjust to teaching online. Until March 2020, the usual school teaching situation was defined by pupils who convened in classrooms according to their timetables and professors who covered the standard content of their topics, sometimes through formal lecturing.

Alternative forms of education were the only way to keep teaching and learning going. Teachers were had to adapt to online teaching, which required them to use a variety of digital tools and resources to address problems and adopt new teaching and learning strategies (Eickelmann and Gerick, 2020). Teachers were required to keep touch with their pupils in addition to their teaching aims in order to account for the social integration of their learning groups.

The introduction of the K–12 curriculum has institutionalized a curricular framework based on spiral growth, necessitating new views in the teaching and learning process. In the digital age, it is widely acknowledged that digital technologies play a significant role.

Having a teaching workforce with the knowledge and abilities to teach suitably is critical to educating children for the digital literacy demands of today's society. O'Byrne (2012) states that effective professional development is critical to the application of digital literacies across the curriculum.

Teachers must employ technology not only because students expect it, but also because educational systems must keep up with developments in online research, communication, and social media in order for students to be prepared for work and citizenship in the twenty-first century (Mihailidis & Cohen, 2013). As a result, not only does the question of whether the lockdown can be compensated for by teachers and students using digital tools in online teaching arise, but it also raises the question of how teachers' competence and opportunities to learn digital competence contribute to teachers' mastery of the challenges of the specific situation. Its goal is to see how capable science teachers are at applying the approach to teach science. As a result, it is empirical to determine the digital literacy and skills of science teachers, as well as the extent of the spiral progression strategy in science education in Butuan City's secondary schools.

Theoretical Framework

The study is anchored in Constructivism, and behaviorism theories. Jerome Bruner was the main proponent of spiral curriculum and was also the proponent of constructivism (Haeusler, 2013). Learning is an active and dynamic process in which learners develop new ideas or concepts based on their current/past knowledge, according to Bruner's thesis. A learner is a purposeful participant in the knowledge acquisition process who chooses structures, retains information, and modifies it. Perception, concept acquisition, and reasoning are all mental processes that rely on a creative creation process (Lucas, 2011).

Cherry (2014) went on to say that behaviorism is another philosophy that falls under this approach. It is a learning theory based on the premise that all behaviors are learned through conditioning, according to her. Interaction with the environment is how conditioning takes place. Our responses to environmental cues, according to behaviorists, shape our behaviors.

Finally, according to the findings of Arksey and O'Malley's (2005) scoping review framework, 1) learner-centered teaching strategies and methods are used, 2) teachers and students have both positive and negative perceptions of its implementation, though they are more pessimistic, and 3) a spiral curriculum generally produces positive results, though there are some notable exceptions. Improved curriculum and pedagogical expertise of teachers, as well as improved varied instructional procedures taking place inside the classroom for mastery learning, can help to increase implementation.

Review of Related Literature and Studies

Ferrari (2012) defined digital literacy as the knowledge, attitudes, and abilities required to identify, locate, access, retrieve, save, and organize information, as well as the amount of competencies and skills required for internet literacy, ICT literacy, information literacy, and media literacy. The goal of digital literacy is to solve problems by using technology and media to gain knowledge in a critical, creative, flexible, and ethical manner.

As a result, teaching competences will be formed by the styles and demands of modern students, who must learn to live and operate in a world that creates large amounts of information (Cardona, 2008). They must meet the needs of students as future engaged citizens in a globalized, digitized, intercultural, and changing society, which necessitates interaction between pedagogy (how it is taught), substantive understanding of what is being taught, and technology in order to be effective (the tools used).

The goal of Cumming et al. (2014) was to examine how the usage of digital technologies affects teaching and learning settings in order to develop ideas to improve their implementation in curriculum design. Some of it focuses on teachers' attitudes and perceptions of using technology in their classrooms, on didactic decisions about which digital tools to use and how to use them, and even on the training needs and demands of teaching staff for properly integrating technology into the teaching-learning process.

Successful implementation is contingent not just on teachers' ability to communicate via digital media, but also on the ability of school managers and administrators. Blau and Hameiri (2010) discovered a link between teachers' understanding and frequency of use of a digital learning management system in the school and their usage of it for parent and learner contacts (in ten secondary schools in Israel). Those who used the system the least were the ones who were least likely to utilize it to communicate with students or parents.

ICT, when properly incorporated into what instructors do, fosters exploration, creativity, and multidisciplinary work, according to De Dios (2013). ICT, when used correctly, boosts learning and improves the spiral teaching technique. 'Great technology may magnify great teaching, but great technology cannot substitute poor teaching,' as the OECD (2015) study concluded. Teachers achieve this by having digital proficiency with equipment and tools; being able to identify appropriate teaching and assessment applications and integrate them into specific lessons and curriculums; and adapting their pedagogical approaches for classroom teaching, guided learning, and formative assessment.

Milliner et al. (2016) conducted a recent survey to assess the digital literacy of language teachers in tertiary education. The authors set out to determine the general level of digital literacy among instructors. They wanted to see where teachers still needed support, as well as how effectively they could perform in a technologically advanced atmosphere. Their definition of digital literacy, on the other hand, was mainly based on practical skills.

Teachers must be able to combine pedagogical and digital abilities and put them to use in the classroom. According to research, the more technological training a teacher has, the more likely they are to be able to successfully integrate ICT into their classroom offering (Hsu, 2010). As the curriculum advances to meet the needs of the twenty-first century, teachers must adapt. Transitions are intrinsically tough for instructors, as Alwardt (2012) pointed out. While attempting to acclimate to the shift, teachers must continue to provide the best possible instruction to their students. As a result, it's critical that instructors are heard and supported at this point.

Statement of the Problem

The goal of the study was to measure the level of digital literacy among secondary school science instructors in Butuan City using the Spiral Progression Approach. The study's goal was to find answers to the following questions:

1. What is the level of digital literacy of the participants in terms of
   1.1 understanding digital practices,
   1.2 finding information,
   1.3 using information, and
   1.4 creating information?
2. What is the extent of implementation of the spiral progression approach manifested by the secondary teachers of Butuan City?
3. Is there a significant relationship on the extent of implementation of spiral progression approach and the digital literacy?

2. RESEARCH METHODS

2.1 Research Design

A descriptive-correlational survey research design was used in this study. Because it is a design to explain the profile, level of digital literacy and extent of spiral development approach, the descriptive method was chosen. It also established a connection between the independent and dependent variables.

2.2 Participants of the Study

The participants of the study were the 80 science teachers of Junior Secondary Public Schools of Butuan City. Purposive random sampling was used to identify the participants.

2.3 Research Instrument

For this investigation, two sets of questionnaires were used. The first section contained the teachers' personal information. The second section used the standardized Digital Literacy Checklist (Ferrari, 2013) to assess the participants' digital literacy. Part 2 focused on Valin and Janer's spiral progression technique along vertical and horizontal articulation (2019). It also included statements in the form of a checklist about how they regarded the aspects of the spiral progression strategy. Pilot testing of the instruments was done among teachers who were not participants in the study to ensure their validity and reliability.

2.4 Data Gathering Procedure

Through a request letter to the Superintendent of DepEd, the researcher obtained permission to conduct the study in all secondary public schools in Butuan City. Following approval of the request, the surveys were transcribed into a Google document in order to collect data online due to the Covid 19 epidemic. The questionnaire link was provided to each of the Science teachers who participated in the study individually. Once all of the information was gathered, it was retrieved and tallied.

3. RESULTS AND ANALYSIS

The participants' level of digital literacy in terms of understanding digital habits. This sub variable had eight constructs. The top indicators are: using online tools and websites to find and record information online, with a mean of 3.76; knowing what types of users you can expect to find online, with a mean of 3.74; and explaining what happens to information you put online, with a mean of 3.74; and explaining what happens to information you put online, with a mean of 3.74, which is described as "Confident."

Finding a person online, such as an expert in your field, and establishing their contact information (3.59), on the other hand, is the least rated indicator. With a mean of 3.68, presenting yourself online: your digital identity and determining what online information you can lawfully re-use. With an average mean of 3.69, the respondents assessed all claims as "confident."

Table 1
Mean Level of Digital Literacy of the Participants in terms of Understanding Digital Practices.

Understanding Digital Practices	**Mean**	**Interpretation**
1. Using online tools and websites to find and record information online.	3.76	Confident
2. Knowing what categories of users, you can expect to find online.	3.74	Confident
3. Explaining what happens to information you put online: your digital footprint.	3.73	Confident
4. Choosing the right tool to find, use, or create information.	3.68	Confident
5. Establishing who owns information and ideas you find online.	3.68	Confident
6. Establishing what online information you can legally re-use.	3.68	Confident
7. Presenting yourself online: your digital identity.	3.66	Confident
8. Finding a person online, for example an expert in your discipline, and establishing their contact details.	3.59	Confident
Overall Mean	3.69	Confident

Legend:
4.50-5.00 (Very Confident); 3.50-4.49 (Confident); 2.50-3.49 (Uncertain);
1.50-2.49 (Quite Confident); 1.00-1.49 (Not Confident).

The findings suggest that science teachers are confident and competent in their knowledge of digital behaviors. This indicates that they are capable of locating information via online tools and websites. They are confident in their understanding of the kind of users they may expect to encounter online. The findings support Shannon's (2017) assertion that "digital literacy" refers to a set of skills essential for full participation in a knowledge society. Smartphones, tablets, laptops, and desktop computers (Personal Computers) are examples of technologies used for communication, expression, cooperation, and advocacy. These definitions assume a binary distinction between knowledge and competency, although in fact, particularly in the educational setting, this distinction is more difficult to discern. Teachers are supported by digital technology to expand the curriculum and improve pedagogical practices in 21st century classrooms.

Table 2 shows the participants' level of digital literacy in terms of finding information. This sub variable has 9 constructs. With an overall mean of 3.87, science teachers appear to be confident in their ability to obtain information on the internet.

Table 2
Mean Level of Digital Literacy of the participants in terms of Finding Information.

Finding Information	**Mean**	**Interpretation**
1. Knowing what information you can find in the web.	4.11	Confident
5. Using social networks as source of information.	4.03	Confident
4. Using keywords commonly used in your discipline to search for information online.	3.95	Confident
2. Knowing what information you can find in an online Library.	3.93	Confident
6. Knowing when to change your search strategy or stop searching.	3.81	Confident
8. Scanning / skimming a web page to get to the key relevant information quickly.	3.81	Confident
3. Using advanced search options to limit and refine your search.	3.75	Confident
7. Filtering large numbers of search results quickly.	3.70	Confident
9. Keeping up to date with information from authoritative people or organizations by subscribing to Really Simple Syndication (RSS) feeds.	3.66	Confident
Overall Mean	**3.87**	**Confident**

Legend:
4.50-5.00 (Very Confident); 3.50-4.49 (Confident); 2.50-3.49 (Uncertain); 1.50-2.49 (Quite Confident); 1.00-1.49 (Not Confident).

Although they are competent in knowing what information they can find on the web (4.11), using social networks as a source of information (4.03), the least rated statement is that they keep up to date with information from authoritative people or organizations by subscribing to Really Simple Syndication (RSS) feeds, with a mean of 3.66.

True, the sheer power and pervasiveness of digital media necessitates the synthesis and critical evaluation of a wide range of information. Furthermore, ethical and legal information use, as well as the security and privacy of the user's and others' information, are critical. Digital literacy is not a static concept: as ICT evolves, so must the definition of digital literacy to guarantee that students gain and use skills in relevant new technologies for information search, transfer, analysis, review, and communication (Ferrari, 2013).

Table 3 shows the science teacher's level of digital literacy in terms of information use. The teachers are confident in utilising available internet material, with an average mean of 3.80. The following are the top indicators: Keeping a note of the relevant details of material you find online (3.90); closely followed by Using information in multiple media, such as podcasts or videos (3.89); and citing a reference to an online resource (e.g. in an assignment) using the proper format (3.90). (3.83). The indicators with the lowest ratings are: Using social bookmarking to organize and share information (3.69); and using other people's work (found online) without plagiarizing (3.70), which is defined as "confident."

Table 3
Mean level of digital literacy of the participants in terms of using information.

Using Information	**Mean**	**Interpretation**
1. Keeping a record of the relevant details of information you find online.	3.90	Confident
2. Using information in different media, for example, podcasts or videos.	3.89	Confident
3. Citing a reference to an online resource (e.g. in an assignment) using the correct format.	3.83	Confident
4. Assessing whether an online resource (e.g. web page, blog, wiki, video, podcast, academic journal article) or person is credible and trustworthy.	3.79	Confident
5. Sharing files legally with others.	3.75	Confident
6. Using other people's work (found online) without committing plagiarism.	3.70	Confident
7. Using social bookmarking to organize and share information.	3.69	Confident
Overall Mean	**3.80**	**Confident**

Legend: 4.50-5.00 (Very Confident); 3.50-4.49 (Confident); 2.50-3.49 (Uncertain); 1.50-2.49 (Quite Confident); 1.00-1.49 (Not Confident).

This means that the teachers keep a record of vital information details online. They have little experience organizing and sharing information utilizing social bookmarking. Furthermore, they may use other people's work while committing plagiarism due to improper citation methods.

This means that the Internet, in particular, has made a virtually limitless amount of information sources available. As a result, the ability to access, identify, extract, assess, organize, and display digital information is becoming increasingly important in the learning process (Argentin et.al, 2014).

Table 4 depicts the level of digital literacy in terms of information creation. Teachers are confident in creating information, as seen by the lowest overall mean of 3.60. With a mean of 3.75, it implies that the teachers are skilled in contributing comments to blogs, forums, or web sites, obeying netiquette and suitable social practices for online communications, and interacting with others online to construct a shared document or presentation.

Teachers are also comfortable writing online for a variety of audiences, such as a web page or blog entry for personal use, for reading by fellow students, for reading by your tutor, or for reading by anybody in the globe (3.66). With a mean of 3.38, people appear to be quite unsure while conversing with others online (forums, blogs, social networking sites, audio, video, etc.). In general, science teachers rated themselves as confident in altering and acquiring data using digital technology. They are proficient in discovering information (3.87), using information (3.87), comprehending digital procedures (3.69), and creating information (3.69). (3.60). In practice, teachers must use a variety of technology abilities in educational activities, one of which is digital literacy. The ability to understand, use, and generate information in diverse formats coming from various sources and presented in computer media is referred to as digital literacy (Ala, 2011)

.Table 4
Mean Level of Digital Literacy of the participants in terms of Creating Information.

Creating Information	**Mean**	**Interpretation**
1. Adding comments to blogs, forums or web pages, observing netiquette and appropriate social conventions for online communications.	3.75	Confident
2. Working with others online to create a shared document or presentation.	3.75	Confident
3. Writing online for different audiences, e.g. a web page or blog entry for private use, for reading by your fellow students, for reading by your tutor, or for reading by anyone in the world.	3.66	Confident
4. Using media-capture devices, e.g. recording and editing a podcast or video.	3.54	Confident
5. Writing in different media for people to read on-screen.	3.46	Confident
6. Communicating with others online (forums, blogs, social networking sites, audio, video, etc.)	3.38	Uncertain
Overall Mean	**3.60**	**Confident**

Legend: 4.50-5.00 (Very Confident); 3.50-4.49 (Confident); 2.50-3.49 (Uncertain); 1.50-2.49 (Quite Confident); 1.00-1.49 (Not Confident).

Teachers are also comfortable writing online for a variety of audiences, such as a web page or blog entry for personal use, for reading by fellow students, for reading by your tutor, or for reading by anybody in the globe (3.66). With a mean of 3.38, people appear to be quite unsure while conversing with others online (forums, blogs, social networking sites, audio, video, etc.).

In general, science teachers rated themselves as confident in altering and acquiring data using digital technology. They are proficient in discovering information (3.87), using information (3.87), comprehending digital procedures (3.69), and creating information (3.69). (3.60).

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Extent of Implementation of the Spiral Progression Approach

Table 5 depicts the extent to which the spiral progression strategy has been implemented. The mean for spiral progression approach horizontal articulation is 4.27, which is described as "always." Life Science, Chemistry, Physics, and Earth Science topics and skills are presented with increasing levels of complexity from one grade level to the next (4.44) and are always implemented. Furthermore, teachers always blend information and abilities from several areas (4.29). Each time a topic is reviewed (4.23), the presentation of the lessons is widened and developed. Lessons, on the other hand, are extended in a more intricate and thorough teaching manner (4.19), and there is often more integration of numerous concepts on each topic presented (4.20).

Table 5
Extent of the Implementation of Spiral Progression Approach.

Indicative Statements	Mean	Interpretation
Horizontal Articulation of the Spiral Progression Approach		
1. The concepts and skills in Life Science, Chemistry, Physics and Earth Science are presented with increasing levels of complexity from one grade level to another.	4.44	Always
2. There is an integration of knowledge and skills across different disciplines.	4.29	Always
3 The presentation of the lessons are broadened and deepened each time a concept is revisited.	4.23	Always
4. There is more integration of various concepts on each topic encountered.	4.20	Often
5. The lessons are extended in more elaborate and comprehensive teaching style.	4.19	Often
Mean	**4.27**	**Always**
Vertical Articulation of the Spiral Progression Approach		
1. The topics discussed in the previous years are needed in the present year.	4.44	Always
2. There is continuity of lessons in the same concept of science in all grade levels.	4.40	Always
3. The topics are reviewed from the previous grade level before introducing new topics.	4.40	Always
4. The progressions of learning competencies of science are discussed in all grade levels.	4.33	Always
5. The presentations of the lessons are broadened and deepen each time a concept is revisited.	4.25	Always
6. The lessons are easy to understand since the same topics are offered in all grade levels at varying level of complexities.	4.20	Often
Mean	4.34	Always
Overall Mean	**4.30**	**Always**

Legend: 4.50-5.00 (Always); 3.50-4.49 (Often); 2.50-3.49 (Sometimes); 1.50-2.49 (Rarely); 1.00-1.49 (Never).

In terms of spiral progression approach vertical articulation, the overall mean is 4.34, which is stated as always. The topics discussed in previous years are needed in the current year, according to the teachers (4.44); there is continuity of lessons in the same concept of science in all grade levels, and the topics are reviewed from the previous grade level before introducing new topics, with a mean of 4.40 respectively.

The least ranked indicators are: the lessons are easy to follow because the same themes are taught at all grade levels at varied levels of complexity, with a mean of 4.20, which is described as "frequently."

In general, the science instructor rated themselves as competent in executing the spiral progression strategy, with an overall mean of 4.30, which is described as "always." The findings are reinforced by De Ramos- Samala (2018), who stated that the Spiral Progression Approach (SPA) in science through vertical articulation gives students with a greater comprehension and deepens their learning ability. The students traced vertical and horizontal articulations after a comprehensive review by the scientific teachers prior to the start of each lecture. As a result, review is vital for gaining mastery of the subject matter.

Digital literacy Relative to Spiral Progression Approach Implementation

Correlation analysis on the extent of the implementation of spiral progression approach with the digital literacy and digital competence of the participants is shown in Table 6.

Table 6
Correlation Analysis on the Extent of the Implementation of Spiral Progression Approach with the Digital Literacy and Digital Competence of the Participants.

Variables	n	Mean	SD	r	Sig. (2-tailed)	Relationship	Sig.
Extent of spiral progression approach implementation	80	4.304	0.504				
Level of literacy	80	3.741	0.736	0.554*	0.000	Moderate Positive Correlation	Significant

Level of significance: α = .05*

According to Table 6, there is a significant relationship between the digital literacy of science teachers (r= 0.554, p value=.000) and the extent of implementation of the spiral progression approach, which means that the increase in understanding, finding, using, and creating information using digital technology is positively related to the extent of implementation.

In the same vein, the science teacher's digital competence (r= 0.597, p value= 0.000) is significantly correlated to their implementation of the spiral progression approach, indicating that as their knowledge and skills and attitude for working, living, and learning in the knowledge society increases, so does their ability.

Casil (2018) backs up this finding by emphasizing the need of teaching science in an integrated strategy that necessitates specialized training. Creating a curriculum that acknowledges the hierarchical order of topics within a field not only offers the environment for learning, but also facilitates the essential teaching abilities. A spiral curriculum that covers a mile-wide range of topics in many disciplines demands far too much of any teacher. A spiral progression technique must take into account the available resources. It is pointless to introduce a curriculum that cannot possibly be applied successfully.

Furthermore, when investigating and becoming acquainted with new technology, the digitally literate teacher should be aware that programs nowadays are considerably better written than those produced a decade or two ago, in that they do not crash as quickly. As a result, they should be able to confidently explore the programs by randomly clicking on tabs, menu functions, and hyperlinks, knowing that these actions are very unlikely to cause the system to crash totally. The more teachers investigate different programs, the more they will notice that there are numerous similarities in the way the instructions work across applications. When teachers gain technological competence, they will be able to assist students with technical problems with less effort and so will not be distracted from the pedagogy and teaching of the subject that students need to learn (Waldrip et al., 2016).

Conclusions

Based on the findings of the study, the following conclusions are derived:

Science teachers are confident in gathering data through digital technologies. The level of digital literacy is high and are competent in finding, understanding, using and creating digital information. The Spiral Progression Approach implementation of the secondary Science teachers is very high. There is a significant relationship between the level of digital literacy in Spiral Progression Approach implementation.

Recommendations

From the series of the findings and conclusions of the study, the following recommendations were drawn:

1. Teachers must be knowledgeable about where and when to use technology for teaching and other related duties. Professional development for teachers is critical to the successful integration of computers in classroom instruction. It is thus suggested that teachers receive training to help them improve their computer skills and understanding.
2. Teachers are expected to utilize technology appropriately. There is a critical need to incorporate digital competence and IT-related issues into school curricula, assessment tests, and classroom practice with a broad knowledge and extensive awareness of digital competence and its underpinning practices, such as the use of collaborative tools and learning management systems. Teachers should be encouraged to acquire additional digital-related skills as part of their ongoing professional development (CPD). Such competencies must also be introduced into various teacher education programs.
3. Successful implementation necessitates teacher support in the form of learning opportunities, embedding digital learning in continuing professional development and initial teacher training, school-wide direction and

leadership, operational digital equipment and tools, and an environment that allows teachers the flexibility to introduce and use digital learning. By offering appropriate interventions, school administrators may help science teachers understand the integration of ICT in the spiral progression strategy and push them to accept the changes in the curriculum. Teachers may be provided additional science content training to better equip them with the knowledge and abilities required for the spiral progression strategy. They may receive additional training in ICT equipment and in the use of new computer programs/applications. Purchase learning resources or prioritize the equipment required in the spiral progression. The principal takes the initiative to provide proper tools and learning resources.

4. Teachers must have theoretical and practical knowledge and skills in science, learning, and science education. The availability and organization of resources, equipment, media, and technology are critical to effective science instruction. The school science program must go beyond the school's walls and into the community's resources.. Although individual teachers are constantly adapting their classrooms, the school as a whole must have a coherent program of science study for students, which is why the suggested increased rules are being advocated. Teachers must be equipped and updated in terms of new methodologies, as well as have knowledge in other domains of science, in order to deliver excellence in science education.
5. Qualitative study on teachers' digital literacy should be conducted in order to obtain more information on the obstacles that prevent and demotivate teachers from integrating technology in schools and other educational institutions. It would also be interesting to question such teachers how they may improve their digital competence and ICT usage. As a result, measuring and assessing teachers in those scenarios could be addressed in future research.

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