Digital Learning: Differentiated teaching models using ICTs to students with vision problems – Good practices: I add by playing from 1 to 10

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Abstract

The idea of inclusion encourages an inclusive, open-door school. By adapting formal instruction to standard instruction that is acceptable for everyone while taking into account the requirements, quirks, skills, interests, and experiences of each student, the use of ICTs aids in this direction. One such group is the visually challenged, whose inclusion in general education classes is made possible with the use of ICTs. In the current study, a method of individualized education in the field of mathematics is developed and put into practice, allowing all students-visually impaired or not-to master the mathematical operation of adding to the first ten at their own speed and time. Results show that differentiated instruction improves students' ability to understand mathematical operations: ADDITION from 1 to 10.

Keywords: new technologies, differentiated teaching, visually impaired students.

Aprendizagem Digital: Modelos diferenciados de ensino utilizando TICs para alunos com problemas de visão – Boas práticas: Jogando entre 1 a 10

Resumo

A ideia de inclusão incentiva uma escola inclusiva e de portas abertas. Ao adaptar a instrução formal à instrução padrão aceitável para todos, levando em conta os requisitos, peculiaridades, habilidades, interesses e experiências de cada aluno, o uso das TICs auxilia nessa direção. Um desses grupos é o dos deficientes visuais, cuja inclusão nas classes de educação geral é possível com o uso das TICs. No presente estudo, é desenvolvido e colocado em prática um método de ensino individualizado na área da matemática, permitindo que todos os alunos-deficientes visuais ou não-dominem a operação matemática de somar aos dez primeiros no seu próprio ritmo e tempo. Os resultados mostram que o ensino diferenciado melhora a capacidade dos alunos de entender as operações matemáticas: ADIÇÃO de 1 a 10.

Palavras-chave: novas tecnologias, ensino diferenciado, alunos com deficiência visual.

1. Introduction

Today, ICTs-especially assistive technology for those with disabilities is a vital tool in the hands of both teachers and students (Chaidi, et al., 2021). Today, ICTs-especially assistive technology for those with disabilities is a vital tool in the hands of both teachers and students (Chaidi, et al., 2021). Information and Communication Technologies (ICTs) currently represent an area on the rise, mainly driven by the new paradigm on social inclusion, which advocates the inclusion of people with disabilities in the various environments of society. For most of these people, ICTs resources are essential for mobility, activities related to learning, about work, communication, and interaction with the world, thus developing the main functions (Rodrigues; Alves, 2013).

According to Galvão Filho (2009), we are experiencing new realities and new paradigms within our society, which is more permeable to diversity, which questions the mechanisms of segregation and thus envisions new paths for the social inclusion of the person, in particular, children with some degree or specific disability. With this, the growing use of ICTs points to a greater relationship with knowledge and development in the construction of the individual for new conceptions and pedagogical possibilities.

Students are given the chance to approach information in a general education classroom through inclusion, and individualized instruction is designed and put into practice. People with visual issues also fall under the group of those with impairments, and they can be particularly challenging when it comes to teaching math. The method for comprehending mathematical ideas, concepts, operations, and symbols becomes approachable with the use of customized instruction and the usage of ICTs (Unesco, 2009).

The aim of the present study is that through a scenario, an example of differentiated teaching using ICT, to approach the knowledge of mathematical concepts, was designed and implemented for visually impaired students in a standard education school. The results show that differentiated teaching can be an educational method and a method of including students in an open school, a school for all.

2. Bibliographic studies

2.1 The role of ICTs in education

In addition, the last few decades have seen significant social changes, which are related in the role of A.I., and technology in people's daily lives. The most important of these concern communication, dissemination and management of information and the ability to assimilate and utilize them produced new knowledge. We must underline that the role of Digital Technologies in the field of education as well as in all aspects of daily life, they are very productive and successful, facilitating and improving it assessment, intervention, decision-making, educational processes and all scientific and production processes through mobile phones (Stathopoulou et al., 2018, 2019, 2020; Kokkalia et al., 2016; Drigas et al., 2015; Vlachou et al., 2017; Papoutsi et al., 2018; Karabatzaki et al., 2018), various T.P.E. applications (Drigas et al., 2004, 2005, 2006, 2009, 2011, 2013, 2014, 2015, 2016, 2017, 2019; Pappas et al., 2018, 2019; Papanastasiou et al., 2018, 2020; Alexopoulou et al., 2019; Kontostavlou et al., 2019; Charami et al., 2014; Bakola et al., 2019; Kontostavlou et al., 2019; Alexopoulou et al., 2019), via AI Robotics & amp; STEM (Drigas et al., 2004, 2005, 2009, 2014; Vrettaros et al., 2009; Anagnostopoulou et al., 2020; Lytra et al., 2021; Pappas et al., 2016; Mitsea et al., 2020; Chaidi et al., 2021), and games (Chaidi; Drigas, 2022; Kokkalia et al., 2017; Drigas; Mitsea, 2021). New Technologies (NT) and more specifically Digital Technologies provide the tools for access, analysis, and transfer of information and for the management and utilization of new knowledge.

Information and Communication Technologies (ICTs), unprecedented human technological possibilities, have a catalyst result, creation of the new social reality and formation of the Information Society (Pappas; Drigas, 2015, 2016; Drigas; Koukiannakis, 2004, 2006, 2009; Drigas; Kontopoulou, 2016; Theodorou; Drigas, 2017; Drigas; Kostas, 2014; Bakola et al., 2019, 2022; Drigas; Politi-Georgousi, 2019; Karyotaki et al., 2022). Additional games and gamification techniques and practices in the context of general and special education improves educational processes and environment, making them more friendly and pleasant (Drigas et al., 2014, 2015; Papanastasiou et al., 2017; Kokkalia et al., 2016, 2017; Doulou et al., 2022; Chaidi et al., 2022)

In conclusion, it is necessary to mention that the combination of ICTs with its theories and models. The cultivation of metacognition, awareness, meditation and emotional intelligence is accelerated and enhanced more about educational, productive practices and decision-making results (Drigas; Papoutsi, 2020; Drigas; Mitsea, 2020, 2021, 2022; Kokkalia et al., 2019; Pappas; Drigas, 2019; Papoutsi; Drigas, 2016; Kariotaki; Drigas, 2015, 2016; Papoutsi et al., 2019, 2021; Chaidi; Drigas, 2020; Drigas; Kariotaki, 2019; Mitsea et al., 2020, 2021; Angelopoulou; Drigas, 2021; Tourimpampa et al., 2018; Kapsi et al., 2020; Drigas et al., 2021, 2022; Galitskaya; Drigas, 2021). Finally, Driga et al. (2019), Stavridou et al. (2021), and Zavitzanou (2021) suggest that various environmental and dietary factors can act as inhibitors or facilitators of improving mental abilities and powers.

2.2 Visually impaired students

One of the categories of children with special needs is children with visual impairments. The classification of children with vision problems is done either based on the degree of visual acuity, the width and narrowness of the visual field (medical definition) or based on the vision made for educational purposes (educational definition).

The term "visually impaired" used for educational purposes includes two groups of students: a) Those with low vision who use the alphabet of the sighted, children who are visually impaired but can read common forms with larger letters (partially sighted), and b) those with little or no vision, blind children who are unable to read common forms but can read and generally be educated with the Braille system.

Special Education for children with vision problems is provided in Special Education School Units, or ordinary educational units for the sighted, where the child with vision problems joins and is taught together with children without vision problems in the same subjects, but with the appropriate and appropriate support: specialized teacher, special aids.

An important part of the education of students with visual impairments is mobility and orientation training, which aims to make students with visual impairments as independent as possible in closed and open spaces, both by specialized staff and as a course as a basic teaching principle on an individual basis in school and at home as well as from the family, as long as he has acquired basic knowledge related to mobility education. Visually impaired people move independently with the help of a white cane, simple or modern with laser beams.

2.3 Mathematics and visually impaired people

Solving mathematical problems is a key axis of teaching mathematics, while for a student with visual impairments, learning mathematics helps to a) develop his skills as well as the ability to understand, and b) acquire appropriate bases for studies, practical practice to find a job (Clamp, 1997).

The key areas of mathematics development in sighted students are seriation, sorting, discrimination, comparison, distance and time, and geometry (Mason, 1997). On the contrary, visually impaired students, as they do not have visual experiences, find it difficult and use touch, touching the objects they are going to classify, or smell, smelling them.

Clamp (1997) referring to the research of Hayes, Nolan, Brothers, and Lewis, students with total or partial blindness had a numerical performance 20-50% lower than their sighted peers, a conclusion which she also confirms in her research (1988) sighted children have a 16-25% better performance in mathematics than children with P.O.

Kohanova (2008) that children with vision problems in Slovakia in the special schools they attended (until 2008, they attended special schools) used the mathematics books in the special Braille script, and with many tactile images, while simultaneously taking notes in electronic notebooks, and using special typewriters to do mathematical calculations, emphasizing the importance of teaching mathematics in organizing the experiences of children with partial or total vision impairment. Kohanova says that mathematics education helps visually impaired students understand numbers to be their use easier in their later life, as it is known that people with visual impairments have difficulty in generalizations, in simple activities of mathematical operations, and in solving problems, especially in the category of fractions, according to Beal et al. (2008), Argyropoulos et al. (2014) and Kapperman et al. (1997).

In Greece, visually impaired students have difficulty in teaching mathematics due to the lack of a common Braille code. The Nemeth code and the Meneides code are used with several differences between them such that they confuse both the trainers and the trainees (Kouropetroglou et al., 2003) svn surveys (Amato, 2002; Kapperman et al., 2003; Karshmer et al., 2002; Argyropoulos et al., 2014) conclude that teachers' limited knowledge of the code they are an obstacle to the proper teaching of children with vision problems, resulting in the non-use of a common language in teaching mathematics, which leads to the use of inappropriate teaching methods and deficiencies in supervised educational materials.

A very useful and supportive tool, in the understanding of mathematics for visually impaired students, is Reference Tables. They allow students to compare, classify, categorize, differentiate, and record similarities and differences between objects and concepts, and relief and three-dimensional reference tables can also be constructed. Goumas et al. (2013) and Panteliadou et al. (2013) argue that the use of hands-on materials as differentiation in teaching is an effective process as they help to understand.

2.4 Differentiated teaching and the visually impaired child

The visually impaired child is one of the students in the class where the words "see", "look", and "read" are used and indicates the methods they see: smell, hear, search, touch I read: in braille, on tapes, at very close range. Teachers encourage visually impaired students to move comfortably in the classroom, participate in all school

activities, ask questions, use their special equipment, keep their obligations, and accept and offer their help to their classmates, in a climate of reciprocity.

The teaching of people with visual impairments follows the standards of differentiated teaching with the following basic conditions both in terms of the teaching space and in terms of the logistical infrastructure. The books for students with severe visual impairments are the textbooks for the sighted, written in the Braille writing and reading code, as the visually impaired student "reads " with the sense of touch, touching the standardized text. while for the partially sighted, the textbooks are printed in larger letters, books written in the braille writing and reading code contain, in addition to the theoretical part, embossed images, geometric shapes, and diagrams for immediate perception, understanding, and clarification of mathematical concepts.

a) Embossed shapes can be made in many ways:

a. In microcapsule paper.

b) On special 20D or 30D "jelly" type paper, on which the shape we want is depicted in relief with a simple engraving.

c) On special thermoform paper.

d) In plain thick cardboard. [D.E.P.S. & A.P.S. FOR BLIND STUDENTS 2004]

b) Braille typewriter, with a basic form of six raised dots (hexagonal).

c) Tape recorders, for the use of talking books, cassettes with written texts, entire textbooks, literary works, etc.

d) Means of viewing and enlarging images, texts, diagrams, etc. for the partially sighted

e) The pencils used by the partially sighted should have a wider tip than usual, write softly, and the paper should be pale yellow (cream) in color and not shiny.

f) The desks should be movable.

g) The walls, ceilings, seats, tables, and other furniture should have neutral colors and should not be shiny.

h) The lighting should spread evenly throughout the room and should not be dazzling.

i) The windows should have a height from the floor commensurate with the age of the children for safety reasons, and the stairs should have protective railings and special markings at the ends of the stairs.

2.5 Assistive technology for visually impaired students

The set of technologies used to support the standard tasks of visually impaired students are called "assistive technologies". These technologies are designed to allow blind users to perform these tasks with comfort and ease. Assistive technologies are divided into high and low-tech (high/low-tech). The first category includes electronic devices and software, such as special-type keyboards for visually impaired people. The second category includes mainly mechanical and electrical devices, such as paper with embossed lines, etc.

Assistive technologies intervene, either to adapt common technologies to the measures of blind users (adaptive assistive technologies) or to completely replace how these people complete daily procedures (alternative assistive technologies). High-level assistive technologies allow visually impaired students to access computers and perform standard tasks or search for electronic information.

Factors influencing the selection of the appropriate assistive device are quality, appropriateness of the device to the type and severity of the visually impaired student's need, and cost. The main problems that the applications of new technologies try to solve here stem from the inability of blind and partially sighted people to access a computer or the Internet, as well as printed information.

Assistive Technology Classes at School

There are thousands of products that can be classified as Assistive Technology in Education:

- ✓ Cognitive or Educational devices, e.g., games controlled by switches, PC, and software.
- ✓ Mobility devices, e.g., wheelchairs, scooters, uprights, any device that serves the person in mobility in his environment.
- ✓ Alternative communication devices, e.g., communication boards or electronic communication boards (talkers), hearing aids.
- ✓ Environmental control devices, e.g., autonomous living aids, communication aids architectural

modifications, and entertainment technologies.

2.6 Visual aids for the educational process

These include enhancing contrast in visual stimuli, enlarging images, and using tactile and auditory devices. Devices that can assist vision include optical or electronic magnifiers, closed circuit television systems for reading/writing, tape recorders, keyboards, printers, and Braille hardware, software, or computer text readers (speech synthesizers), photocopiers that enhance contrast to the text.

- ✓ Entertainment, Leisure, and play

Assistive Technology devices for entertainment and play include different software such as painting and electronic games.

- ✓ Visual keyboard

On-Screen Keyboard is a utility that displays a virtual keyboard on the screen and allows users with mobility problems to type data with the help of a pointing device or joystick (Turli, 2020).

2.7 Project description

In the context of the good practices of differentiated teaching mathematics to visually impaired students, a scenario, and a lesson plan with the use of ICTs are presented.

"Title: "I add by playing from 1 to 10"

2.7.1 Cognitive areas involved

This didactic learning scenario is addressed to 1st-grade students of a general school for students with typical development. Among them, there is an amblyopic student with partial loss of normal vision.

The subjects involved in the scenario are Mathematics, Language, and ICTs. The educational scenario is perfectly compatible with the school's Analytical Curriculum since the central axis is part of the A.P.S. of Grade 1 Mathematics: [14] "Numbers and operations" where it is intended to recite, read, write, and order the natural numbers as well as perform addition and subtraction operations. Also, the goals that are set are fully related to the analytic program of the Language, and the T.P.E.

2.7.2 Pre-requisite knowledge

Students already understand the concept of the multiplicity of numbers, recite, read, write, and order the natural numbers from 1-10, on the number line to place the numbers "before" and "after" Also, the children are familiar with the use of the Computer in terms of the learning process of the Analytical Program courses.

2.7.3 Objectives of the teaching scenario

The teaching unit "I add by playing from 1 to 10 " is a scenario for including visually impaired students in a general school classroom. The importance of the tactile approach and experiential learning in an educational teaching subject of major importance in people's lives such as mathematics is emphasized! The main goal is for the student, either with prompting or alone, to learn to follow a series of visually represented steps counting from 1-10. The student is trained to follow visual instructions with photos, images, word symbols with the ultimate goal of integrating students with diversity into the school community and by extension into society (Table 1).

Specifically:

Table 1. The objectives of the scenario.

The objectives of the scenario are:

A) Cognitive objectives:	**B) Regarding the use of ICTs**	**C) Regarding the learning process**
The teaching unit "I add by playing from 1-10" aims for the students to: a) to understand the addition to ten b) perform additional operations	ICT enables students to develop new skills, to acquire a new kind, of more comprehensive knowledge, as well as ICTs can be new learning environments, that is, environments in which learning can take place in a much more efficient way. Specifically: To practice in the use of computing tools (navigating the network) To obtain positive attitude towards the use of ICT in the learning process. To be addicted to active search and processing of information. To become competent the students: 1) seek, 2) to identify, 3) analyze, and 4) process information online.	Students are expected to: to cooperate and interact to achieve the proposed goals. To activate a propensity for exploratory and collaborative learning. to familiarize themselves with the investigation and selection of information through the rich material of the internet or the information material provided by the software.

Source: Authors, 2023.

2.8 Duration

Calculated that the temporal duration of didactic scenario I will is duration 2-3 didactic hours.

2.8.1 Teaching materials - software category - combination of software and application categories

To implement the scenario will be used:

a) Internet: The Internet will be used with recommended websites for watching videos. Guided exploration-discovery.

b) Microsoft Office software and the Word application.

Word will be used to create a worksheet for student assessment.

2.9 Content analysis

The scenario took place in the school's computer lab and in the classroom, where there is a computer and an interactive whiteboard. All computers have internet access.

The objectives set at the beginning of the m-scenario were achieved during its implementation. Students are helped by using visual representations and activities because they are more engaging and enjoyable.

For the teaching of mathematics to students with visual impairments, it is planned to use real objects, e.g., buttons, bricks, sticks, etc. To create collections and list-objects. Embossed cards, abacus, sticks, cubes, straws, plastic cups, and other three-dimensional materials for analyzing two-digit numbers in tens and ones, adding, and subtracting numbers up to 10.

Also, the installation of a magnifying glass and screen reader program is an important help in differentiating-modifying teaching for the benefit of the student. Also, in the software, the information is verbalized, whether it concerns the pronunciation of the exercise or the mathematical formulas that the student is asked to solve.

Finally, the adaptations and modifications to be effective must take into account: a) the individual needs of the students, b) the requirements of the lesson in which the adaptations will be made, c) how the teacher and the school administration perform their roles and d) the use of technology.

2.10 Organization of the department

Teaching Inside – Materials Learning

This particular scene took place in the computer room of the school with the software used pre-installed. The school room teaching has a PC, and laptop, with access to the Internet, an Interactive Table, a video projector, and a printer.

The means used it's the: Internet, YouTube, Sheet work in form doc., buttons, bricks, sticks, etc., Embossed tabs, abacus, sticks, cubes, straws, plastic cups, the magnifier, and screen reader program installation.

2.11 Teaching approaches and strategies

Theoretical Approach

Students in groups of two are involved in the activities in the context of cooperative learning and discovery, helping and complementing each other. Throughout the group work the teacher guides advise and observe the process, without intervening except when requested.

The student with partial vision loss works harmoniously with his classmate while using the magnifying glass tool, which the teacher from the beginning of the lesson had adjusted according to the visual ability of the partially sighted student, at the 2x magnification scale, and is quite productive.

2.11.1 Methodological approach

In this scenario, ICT is used as well as conventional materials, numbering boards, buttons, cardboards, etc. to understand numbering. Experiential, exploratory learning as well as cooperative learning between students are used to approach and understand the act of counting, a mathematical act that is a basic act in the student's daily life, just like basic mathematics.

2.11.2 Teaching approach with ICTs

The module includes pedagogical activities utilizing ICT technological tools through which an attempt will be made to inform the students on the subject of teaching, and, above all, to consolidate and acquire everyday skills: hand washing.

2.12 Summary description and justification of activities

The activities that were selected are: The students recognize her sequence- steps for the washing of hands (experientially and digitally).

2.13 Project analysis

2.13.1 Project analysis

SCRIPT TITLE " "I add by playing from 1 to 10"

Class – Students:

Educational level / Level: This didactic learning scenario is aimed at A' students in Elementary school one general school students standard development. Between them, there is a blind-eyed pupil with partial loss of vision her normal.

Typical age range: 7 years old.

1. Scenario Description

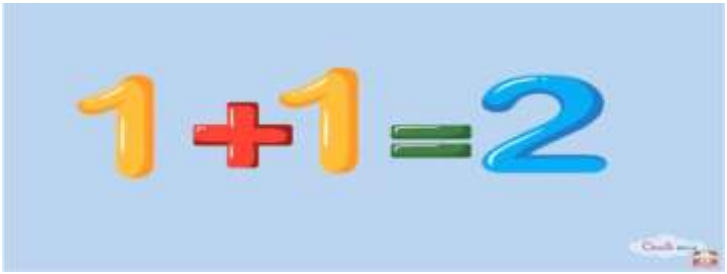
The teaching follows the following structure:

1St teaching hour:

Activity 1 h

It's happening discharge with the "song her addiction" https://www.youtube.com/watch?v=8uIv5tploTI

The song is displayed on the interactive table. The interactive panel gives the ability to magnify and change the contrast.



Activity 2:

Requested by their students to place on the desk they're the box the plastic chopsticks, the buttons, their markers, and the bricks their

(where already placed in separate bags), as and her colored surface work where each pupil performs the tasks.

They are called the students to perform exercises such as:

E.g., Put it on above in the frame: 3 buttons and 2 bricks.

Count it now How many are all together? Etc...

Activity 3:

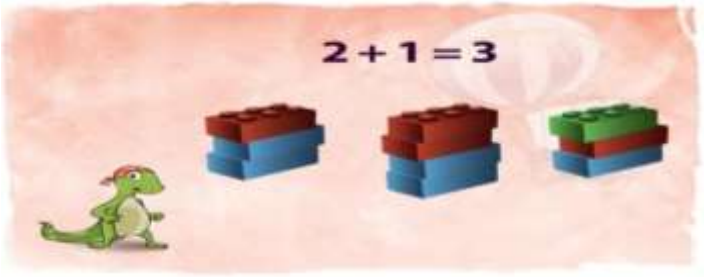
The students use the abacus, and they do additions according to the exercises that are pronounced from her education.

Activity 4:

"I'm learning addition" http://www.mikrapaidia.gr/ccs7/#%CE%B5%CF%80%CE%AF%CF%80%CE%B5%CE%B4%CE%BF-4

From the above web page displayed in the interactive, we choose the exercise, where is presented the addition.

At Continuity, the students in group 2 solve additions from her exercise. The blind student and his classmate, working together, use the aid of magnifying glass lens we have adjusted her projection, Pi. h. 200% such as the size of her font.



2 [and] Teaching Hours:

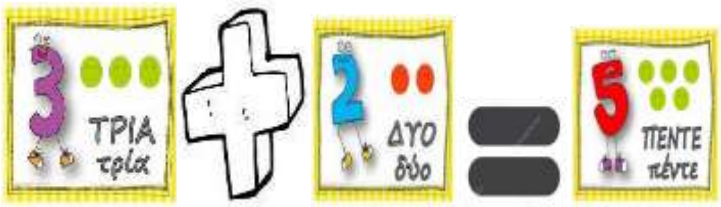
Activity 5 [h]

The students are in groups of 2, by Sebran software which is already known.

It is selected the activity " Addition" and performs the additions**.**

Activity 6 [h]

We have printed tabs with numbers and math symbols (+, =), and for students with visual impairments cards with embossed numbers and symbols. The relief numbers also must be printed and to Braille. Again _ _ in individual surface work wanted their students to use the tabs and yes, they do additions. E.g 3 + 2= **5**



3[rd] Teaching Hour:

Evaluation of students.

Activity 7 [h]

Activity evaluation.: From the software, Sebran selected the activity "It's raining additions."

Source: Authors, 2023.

3. Results

3.1 Evaluation – Feedback

The goals set at the beginning of the m-scenario were achieved during the implementation of differentiated teaching, discovery, and experiential learning by implementing activities in real conditions. The students collaborated with each other and with the visually impaired student. The use of conventional materials (bricks, abacus, abacus, etc.) as well as digital materials helped both the visually impaired student and the students without special educational needs or disabilities to understand the concept of counting from 1-10 and act of adding to the first ten.

4. Conclusions

Finally, we must underline the role of digital technologies in the field of education, which is very productive and successful, facilitates and improves assessment, intervention. From the feedback of the tasks, it is clear that the differentiated teaching, the combination of tpe, through discovery learning, with experiential learning and the tactile way of teaching helps to approach, develop, improve, understand the arithmetic operations and in this work its addition to top ten.

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6. Auhors' Contributions

The 1st and 2nd authors (*Paraskevi Lykou* and *Irene Chaidi*) designed the activities for the scenario after discussion with the applied department's teaching staff. The 3rd author (*Anna Maria Drigal*) was the teacher of the class where differentiated teaching was implemented according to the student potential of the class.

7. Conflicts of Interest

No conflicts of interest.

8. Ethics Approval

Not applicable.

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