Jurnal Pendidikan Kimia Indonesia
Volume 7, Issue 1, 2023, pp. 10-18
p-ISSN: 2087-9040 e-ISSN: 2613-9537
Open Access: https://doi.org/10.23887/jpk.v7i1

Application of Student Worksheets Based on *Hyperdocs* in Chemistry Learning on Scientific Creativity

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ARTICLE INFO

Article history:
Received February 09, 2023
Revised February 12, 2023
Accepted March 29, 2023
Available online April 25, 2023

Kata Kunci:
Hyperdocs, Kreativitas Sains, Pembelajaran Kimia

Keywords:
Hyperdocs, Science creativity, Chemistry Learning

ABSTRAK

Masalah kreativitas kini dianggap sebagai kemampuan/keterampilan yang krusial bagi masa depan pendidikan dan pekerjaan. Saat ini kreativitas dipandang sangat perlu ditingkatkan dalam proses pembelajaran untuk mencapai kualitas pembelajaran yang lebih baik. Penelitian ini menggunakan deskriptif–kualitatif yang bertujuan untuk mendeskripsikan penggunaan Hyperdocs terhadap kreativitas sains siswa SMA Labschool UNTAD Palu pada materi larutan penyangga. Subjek penelitian terdiri dari 20 siswa yang diperoleh berdasarkan teknik purposive sampling. Instrumen pengumpulan data menggunakan LKPD berbasis hyperdocs yang terdiri dari 14 soal kreativitas sains yang telah divalidasi oleh tim ahli. Berdasarkan analisis data persentase dan kateori kreativitas sains, maka tes soal pada sesi pertama dan kedua memperlihatkan nilai rata–rata pada aspek unusual uses, problem finding, product improvement, creative imagination, dan problem solving berada pada kategori baik. Selanjutnya, untuk aspek science experiment dan product design berada pada kategori cukup. Sehingga dapat dikatakan bahwa secara keseluruhan kreativitas sains siswa SMA Labschool UNTAD Palu kelas XI MIA 1 berada pada kategori baik.

ABSTRACT

Creativity problems are now considered a crucial ability/skill for the future of education and work. Currently, creativity is seen as urgently needing to be improved in the learning process to achieve better learning quality. This research was a descriptive-qualitative that aims to describe the utilization of Hyperdocs towards scientific creativity of SMA Labschool UNTAD Palu students in chemistry learning on the buffer topics The research subjects consisted of 20 students who were obtained based on a purposive sampling technique. The data collection instrument used hyperdocs-based worksheets which consisted of 14 scientific creativity questions that had been validated by a team of experts. Based on the analysis of percentage data and the category of scientific creativity, the test questions in the first and second sessions showed that the average scores for the aspects of unusual uses, problem finding, product improvement, creative imagination, and problem-solving were in a good category. Furthermore, the science experiment and product design aspects are in the sufficient category. So that it can be said that overall the scientific creativity of SMA Labschool UNTAD Palu class XI MIA 1 is in a good category.

1. INTRODUCTION

Creativity problems are now considered a crucial ability/skill for the future of education and work. Currently, creativity is seen as urgently needing to be improved in the learning process to achieve better learning quality (Novianto et al., 2018). Creativity has a special domain, so it is necessary to distinguish between scientific creativity and creativity in general. Scientific creativity can be defined as motivation in scientific research, scientific by producing original products, having social and personal values, and designing with specific ideas based on available knowledge (Amabile & Pillemer, 2012). Scientific creativity emphasizes the ability to generate new ideas and products that are relevant to a scientific context (Sidek et al., 2020). In addition, scientific creativity is centered on finding and solving problems through various creative experiments consisting of personality and product dimensions (Hu & Adey, 2002; Kim, 2006;

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Kharkhurin, 2017). There are 4 personality factors, namely fluency (number of relevant ideas), flexibility (covering the responses given), and originality (number of ideas that are rarely raised). While the product involves creative aspects and imagination. The important characteristics of scientific creativity are self-evaluation, encouragement, self-confidence, openness to ideas, and flexibility (Walsh et al., 2013). In scientific creativity, the dimensions of creative thinking, scientific knowledge, and scientific research skills are needed (Park, 2011) so students need to experience and investigate the natural environment directly (Krulwich & Burkey, 1996; Plambech & Konijnendijk van den Bosch, 2015). In learning chemistry, scientific creativity will make a high contribution to the formation of student attitudes. The relationship between the two can affect performance in learning (Nursiwan & Hanri, 2023). The formation of a scientific attitude will have an impact on the development of students' scientific creative thinking skills (Yuliatin et al., 2021). Previous research identified that scientific creativity worksheets were more effective in improving students' thinking skills even though they did not utilize digital technology. Therefore, scientific creativity needs to be supported by the development of digital technology. Be a pioneer in the classroom and the future of education that can equalize student learning conditions (Aguilar & Turmo, 2019). Previous research has shown that technology-based collaborative learning provides tools that can enrich learning contexts and encourage creative processes (Lee & Chen, 2015; Henriksen et al., 2016).

The use of HyperDocs is one of the ways used to combine digital technology in developing worksheets concerning students' scientific creativity. HyperDocs-based worksheets utilize the internet network, are not in printed form, and are creatively designed so that worksheets are not provided spontaneously. HyperDocs is a digital literacy platform that was first developed by Highfill et al. (2016). contains digital lesson plans that can be designed by teachers and given to students. According to Highfill et al. (2016) that this platform can encourage students to provide ideas, investigative choices, exploration, critical thinking, collaboration, and of course trigger creativity. Walanda et al. (2023) also show that the use of HyperDocs in creating digital student worksheets can improve student collaboration skills. So HyperDocs is a very interactive Google Docs, used as a substitute for student worksheets in conveying material in a blended learning manner. There are so many reasons why using technology like HyperDocs can change teaching: 1) students are users of digital technology; 2) technology allows students to form relationships with peers outside the classroom, school, and even students can work from home; 3) technology can act as a catalyst for students to be more creative; 4) technology facilitates students to share work in large numbers.

Based on an interview with the chemistry teacher at SMA Labschool UNTAD Palu in August 2021, students' scientific creativity was still very low and it was seen when the teacher asked questions, students tended to be quiet and less active. Few students expressed their opinions due to the lack of students' attention in learning chemistry. In addition, in the current era of the Covid-19 pandemic, many students are having problems understanding chemistry concepts. There are several efforts to increase scientific creativity in chemistry learning, one of which is by applying student worksheets. Learning by using student worksheets can provide opportunities for students to understand or work on existing problems independently. Therefore, student worksheets are needed that can increase scientific creativity by applying Hyperdocs-based student worksheets. In addition, there has been no study of the application of HyperDocs-based student worksheets in chemistry learning regarding scientific creativity, so this paper aims to describe how the level of scientific creativity of students through the application of Hyperdocs-based worksheets in chemistry learning.

2. METHOD

The type of research used in this research is descriptive qualitative. The data source came from 20 students of class XI MIA 1 Labschool UNTAD Palu. The research was conducted by collecting data through HyperDocs-based worksheets (LKS) containing 14 validated scientific creativity questions. The research focused on examining students' scientific creativity through several aspects, namely unusual use, problem finding, product improvement, creative imagination, problem-solving, science experiments, and product design on buffer solution material.

The initial stage was designing the HyperDocs-based worksheet which included 1) compiling the research instruments used to measure the validity of the HyperDocs-based worksheet including, following the questions on scientific creativity and the scoring rubric, compiling a media validation questionnaire, a validation questionnaire about scientific creativity and the scoring rubric; 2) the selection of the HyperDocs-based LKS format about the design of enhancing students' scientific creativity and the constituent components of the LKS in general, namely: the title of the HyperDocs-based LKS is the nature of the solution worksheet and the working principle of the buffer solution as well as the pH determination worksheet and the role of the buffer solution, student identity, instructions for use HyperDocs-based worksheets, learning objectives, short theory and videos related to the material, as well as scientific creativity questions sorted according to the aspect level.

Next stage was that producing valid instruments based on examination and input from the expert team. The results of revisions to the HyperDoc-based LKS format will be stored as Google Docs. The instrument is ready for use so the next stage is the application stage. HyperDocs-based worksheets will be applied to 20 class XI MIA 1 Labschool UNTAD Palu students selected based on a purposive sampling technique based on the considerations of the chemistry subject teacher. Students independently work on HyperDocs-based LKS by accessing the HyperDocs link provided by the chemistry subject teacher. The HyperDocs-based LKS design is made uniquely and attractively so that students are interested in working on it. In addition, students can access HyperDocs-based worksheets anywhere and anytime according to the pace of student self-learning (Highfill et al., 2016).

The final stage is data collection techniques. Data on students' scientific creativity abilities were obtained by giving HyperDocs-based worksheets 2 times. The first test consists of 7 questions regarding the nature of the solution and the working principle of the buffer and the second test is about determining the pH and the role of the buffer in everyday life. The results of the student answers obtained were analyzed concerning the rubric of answers to scientific creativity questions and then the percentage of achievement was calculated which determined the category of students' scientific creativity abilities according Widoyoko (2009) as shown in Table 1.

Table 1. Percentage and Category of Scientific Creativity

Percentage	Category
80≤X≤100	Very Good
60≤X<80	Good
40≤X<60	Enough
20≤X<40	Poor
0≤X<20	Very Poor

The HyperDocs-based worksheet consists of questions according to indicators of scientific creativity: unusual uses, problem finding, product improvement, creative imagination, problem-solving, science experiments, and product design (Kind & Kind, 2007).

3. RESULT AND DISCUSSION

Result

The instrument validity test was obtained from the validator by examining the results of the assessment of the instruments that have been prepared. The results of the study were used as input for revising/improving the instrument (Harjono, 2017). Validation resulted in 14 buffer solution questions associated with students' scientific creativity. The instrument is considered valid if a validity value of ≥61% is obtained (Centaury, 2015). The percentage of content validity that was presented reaches 81.25%, showing that students' worksheets are presented automatically, the problems raised are following the students' condition, the activities presented in the student worksheets have clear objectives, the activities presented foster curiosity, and the presentation is equipped with pictures and illustrations, there also an appropriateness of component content and easy-to-understand text sentences. The content of the questions on the instrument represent all possible questions asked about the content and skills (Creswell, 2005) in this case scientific creativity. As well as for the language aspect which reaches a percentage of validity of 80%. The language used can be understood and using EYD sentences were arranged precisely and clearly, word are not repeated, and the terms used are appopriate. Then related to the display or design of student worksheets based on hyperdocs the percentage of validity is 80%. Cover according to the topic of buffer, the size and picture were appropriate, attract students' attention, the shape and size of the writing used as a learning resource also helps students in finding concepts.

Student worksheets based on Hyperdocs in their use require an assessment rubric so that seeing students' scientific creativity becomes more objective. The first aspect is the suitability of the material based on the validation results showing a percentage of 90%. In this section, the assessment rubric covers all indicators of scientific creativity, the statements made are also following the indicators, as well as revealing the aspects studied. The construction of the assessment rubric shows a percentage of validity of 80%.In this case, the statement has been formulated, according to the needs of the topic, is not ambiguous, there are no statements that lead to the same topic, and the statements are coherent and systematic by the order of the topic of the buffer solution. The third aspect is that the use of language in the rubric of the assessment of scientific creativity shows that it is very valid (100%). This rubric is logical and easy to understand, uses improved spelling (EYD), does not use the local language in each statement, and statements use common words.

Based on the results of students' answers to 14 questions (tests 1 and 2) in Hyperdocs-based worksheets, the value obtained from the results of data analysis is presented in Figure 1. The first test uses 7 questions regarding the working principle of a buffer solution. Data analysis shows that the aspects of scientific creativity are unusual uses with a percentage of 67% in the good category. Where when faced with an unusual problem, students do not yet have problem-solving skills but it is good to know various things (Webb et al., 2021) in this case knowledge about the nature of buffer solutions in liquid medicine to relieve excess stomach acid. Problem finding is an aspect to see students' ability to find real problems in everyday life. The percentage level is 70% which is included in the good category. Students in this aspect can find problems but are unable to construct problems related to what is presented. Furthermore, the problem-solving aspect with a percentage of 68% is in a good category. The results of students' answers show their ability to identify to define the problem in this case which components are included in the buffer solution for the case presented. However, students have not been able to explore problem-solving in depth. Aspects of student product improvement are in a good category with a percentage of 60%. Based on the cases presented, students have not been able to explain how the buffer solution works in eye drops and can only mention replacement eye drops.

Furthermore, the creative imagination aspect in terms of the function of the buffer solution in the body and its effect on students is also in enough category with a percentage of 57%. The ability of students in imagining is limited to what is said by the book but are not able to further explore the knowledge gained. For the science experiment aspect, students are also in enough category with a percentage of 52%. Students cannot explain the procedure for making buffer solutions correctly and precisely. Students are accustomed to using the procedure according to the chemistry textbook. The last aspect is product design which is also in enough category with a percentage of 53%. Students in this aspect are not able to design tools and materials used to make jackfruit seed milk. In addition, students have not been able to identify the content of the compounds and the reactions that occur in them.

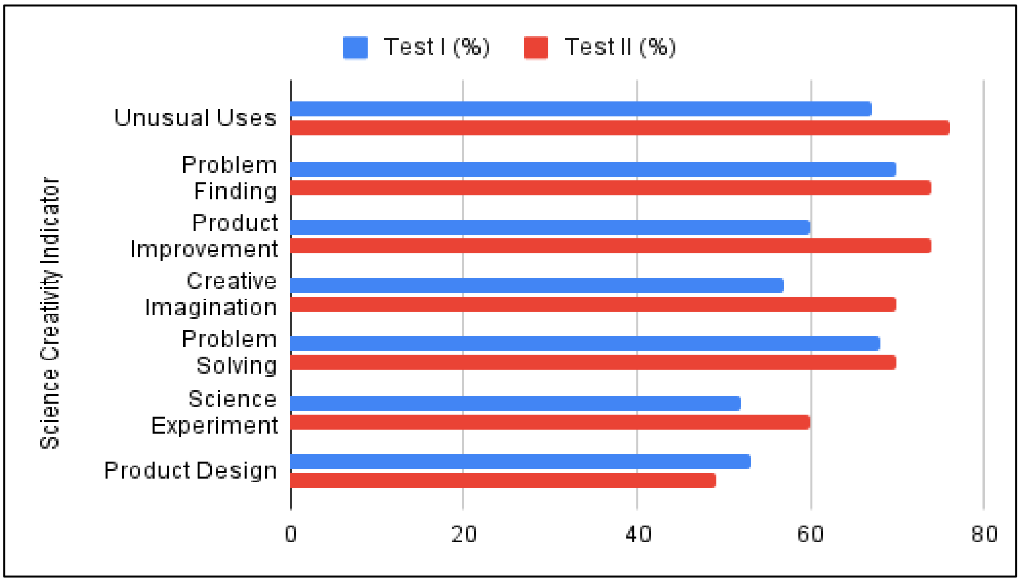

Figure 1. Measurement Results of Students' Science Creativity Analysis on Tests 1 and 2

The second test also looks at 7 aspects of scientific creativity on the function and role of buffer solutions in everyday life. The results of student answers showed an increase in the percentage of the unusual uses aspect with 76% of participants in the good category. In the second test, students were able to mention the unusual uses of buffer solutions in everyday life which were new to students. Aspects of problem-finding and problem-solving also showed an increase in the percentage of 74 and 70% in the good category. However, the student's ability to find the pH value in an experiment is limited to arithmetic operations and not microscopic concepts. In addition, in solving problems, students in answering questions in general can show the relationship between the known pH and the acid solution that will be selected according to the value of Ka presented. The percentage increase was also seen in the product improvement and creative imagination aspects with a percentage of 74 and 70% included in the good category. Through the cases presented, students' abilities increase in determining substitute products that can maintain body pH when dehydration occurs and how the product works. An increase in the creative imagination aspect of students, namely their ability to explain the effect of pH levels in the blood. Students have been able to explain the problems that occur in the human body when body fluids are too acidic or alkaline and their relationship with blood pH. However, in the aspect of a science experiment, although there is an increase in the percentage of 60%, it is still in the good category. Through video identification by students, their ability is limited to identifying the solution contained in the beaker and the added NaOH solution. Furthermore, students have not been able to identify the problem that occurs when the two solutions are added. Meanwhile, the product design aspect decreased by 49% in enough categories. The ability of students in producing a carbonated beverage product is limited to their ability to mention the tools and materials used and cannot explain the manufacturing process, as well as the effect of the buffer solution contained in it.

Discussion

Validation of student worksheets based on Hyperdocs and the rubric of scientific creativity is an effort to obtain worksheets based on Hyperdocs and the rubric of science creativity with high validity. Validity is carried out through validation tests carried out by experts (Akbar, 2013). According to Fraenkel et al. (2011), the validity of the instrument can be tested through the validity of the content, constructs, and criteria. Results from the instrument that has been validated are used to measure scientific creativity, namely the ability of students to use knowledge and skills to produce creative products that have individual and social value through the creative process (Egan et al., 2017). The purpose of this research is to see how the level of students' scientific creativity by using student worksheets based on HyperDocs on buffer material. Previously, Hu & Adey (2002) designed the scientific structure creativity model (SCCM) which produces three main dimensions and 24 aspects. However, students' scientific creativity in this study was identified into seven aspects and each measured the core of scientific creativity including unusual use, problem finding, product improvement, creative imagination, problem-solving, science experiments, and product design (Kind & Kind, 2007).

The student's unusual use level is at a moderate level and increases to a high level on the second student worksheet. In the first test, students try to give opinions about scientific cases presented in a YouTube video. In this case the ability of students to predict the unusual nature of the buffer in gastric acid drugs to how the buffer is used in everyday life. The results of the identification show that students use knowledge about buffer solutions related to drugs based on the information presented in printed books. For example, what is meant by a buffer solution, and how it behaves when an acid or base solution is added? Very few students convey ideas about the use of buffer solutions in stomach acid medicine directly about how the function of buffer solutions can neutralize the pH of stomach acid (Samuelsen et al., 2019). If studied further, the information presented by students is what they usually find in learning references in the classroom. There are no unusual uses of buffer solutions in everyday life that they can share. There is an increase in this second test. In this section, students experience development in conveying unusual things from the use of buffer solutions in everyday life. Not limited to its function as a neutralizer when adding acids and bases, but how to use as a pH controller for blood, food, plants, eye drops, industrial waste, and shampoos that are often used daily. Students begin to be able to recognize their understanding and find things that are not known and become new information for students and are closely related to their environment. According to Silvia et al. (2014) to check the extent of creativity in the surrounding environment, students should ideally have direct experience.

The next aspect is a problem finding where students analyze the waste treatment process through an anaerobic process and identify buffer solutions and determine the pH in the first test. And in the second test students identify the manufacture of buffer solutions. Although there was an increase in the second test, it was not significant. Problem finding is considered the initial stage of the creative problem-solving process. Troubleshooting includes anticipating problems, identifying unrecognized issues, and aggregating unclear issues so that troubleshooting efforts can proceed (Reiter-Palmon & Murugavel, 2020). The ability of students in the process of finding a problem is at a good stage. Where in general students cannot go through the step from the questions asked, students are fixated on how to find the final result without recognizing the real problem. students need to understand that problem-finding is a stage for students to create problems for themselves (Hu et al., 2010). The results of this study are supported by previous studies which found students had difficulty understanding buffer solutions caused by a lack of understanding of the concept of buffer solutions, students' lack of mathematics, interest, and motivation in learning, and teacher teaching methods (Sanjiwani et al., 2020), and students also experience difficulties in connecting buffer solutions and chemical equations and calculating the pH of buffer solutions (Firdaus et al., 2022).

The product improvement aspect in this case tries to find a product that can be used to replace plain water as an eye cleanser when there is dirt in it. Most of the students described the product in the form of eye drops but did not specify the type and content. Likewise in test II, students could not develop answers more broadly. Students give answers in the form of electrolyte solutions and do not explain in detail the product in question. In addition, even though is in a good category, judging from the buffer solution material, students only know the benefits of buffer solutions in sustaining life but fail to make a connection between pH and the reactions that occur (Orgill & Sutherland, 2008). The ability of students to produce product improvement is still very limited. If examined from the flexibility of Hyperdocs, it supports students to be able to develop their creative ideas by displaying images or videos that are directly connected without the need to open a new window in the search browser (Carpenter et al., 2020; Walanda et al., 2023). Students' habits in using paper and pen in the classroom are still attached even though writing and reading competencies have changed the use of digital technology (Vincent, 2016).

Creative imagination directs students to measure students scientific imagination and can be used to assess fluency, flexibility, and originality (Handayani et al., 2021; Jankowska & Karwowski, 2015; Karwowski & Soszynski, 2008). In this case, students predict what if in this body there is no buffer solution component and if blood pH levels in the body are not balanced. Students' abilities are in the enough and good categories can be seen in Figure 1. The answers given by students were able to answer questions but were very limited to the benefits provided, for example, related to organ damage or body fatigue. According to Jankowska & Karwowski (2015), Students who have creative imagination can make and change representations and go beyond past observations. This research shows that students can produce one main idea about the effects of pH imbalance in the human body. But what happens next is that students have not been able to provide transformative thoughts from the consequences that arise. Thus, it is necessary to rethink the importance of creative imagination in constructing the meaning of learning chemistry (Holme, 2021). Scientific imagination needs to be increased effectively so that students can master chemical concepts down to the submicroscopic level (Abdullah et al., 2018).

The most important aspect of other scientific creativity is the ability to adapt to changes and the ability to solve problems that arise and the ability to find alternative answers (Krumm et al., 2016). To see this ability, students can distinguish between buffer solutions and non-buffer solutions. The results of the research show the ability of students in the good category can be seen in Figure 1. In these two tests, students can determine which is a buffer solution and not a buffer solution even though it is not answered specifically according to the assessment rubric. The average student's answer relates to their ability to maintain pH and is not studied step by step. Students do not identify the problems that arise but directly write down the properties of the buffer solution. At the problem-solving stage, students were not well directed and wrote down the effect of adding acids and bases or buffer solutions, and did not know the components of the buffer solution which were clearly described in the problem. In the end, giving conclusions is not able to fully answer the intended results. According to Kim & Tan (2013), in solving problems students need to learn to share ideas, combine types and levels of knowledge, and communicate to find solutions.

In the next case, students are focused on making buffer solutions and making observations in mixing buffer solutions. The ability of students in enough categories can be seen in Figure 1. In tests, I and II the ability of students did not increase specifically. In the science experiment phase, apart from conducting experiments students are asked to design experimental procedures using HyperDocs. From the students' answers, it can be identified that their ability to design procedures is very limited. Students are accustomed to using the worksheets that are already available. Most of the students mentioned the procedure of directly mixing the CH_3COOH and CH_3COONa solutions, the other students only wrote down the procedure, namely mixing the available solutions. Experimental activities should include developing the discovery process and developing students' scientific creativity (Agustin et al., 2021). However, the results of the research produced did not find the same thing. The science experiment test in test II also showed the same level. Experimental videos are provided by simply clicking on the link that has been attached to the Hyperdocs document, so students can carry out experiments online without the need to visit the laboratory in person. Also in this aspect, students have not been able to develop creative ideas and mindsets. Students can fill in the observation table but cannot identify the problems that arise in the experiment.

Product design is the ability to design scientific products creatively. This design can measure product flexibility, technicality, originality, and imagination thinking (Hu et al., 2010). In this case, students are predicted to be able to design products from the manufacture of jackfruit seed milk and the manufacture of carbonated drinks. The ability of students in enough categories can be seen in Figure 1. Students are only able to design tools and materials, and how to make them, students are not able to write down the content, similarities, and reasons why the drink contains a buffer. In designing a chemical product, it is very important to pay attention to a systematic design framework (Fung & Ng, 2018). The results of student work in several aspects have shown a design framework such as the steps for making beverage products in which there is a buffer solution system. Very few students described the composition of the product to be produced or its properties. By giving assignments to students to design products, students are trained to have skills, look for concepts and meanings and build knowledge based on experiences that have been experienced (Pamenang et al., 2020).

4. CONCLUSION

The application of worksheets based on Hyperdocs shows the level of students' scientific creativity in the aspects of unusual use, problem finding, product improvement, creative imagination, and problem-solving are in a good category while the science experiment aspects and product design are in the sufficient category. Hyperdocs-based worksheets can measure students' scientific creativity and provide new findings regarding media that can be used by teachers to change the habit of using paper-based worksheets. In addition, it can also be used to identify students' scientific creativity abilities in other chemical materials.

ACKNOWLEDGEMENT

The participation and the time spent of SMA Labschool UNTAD Palu students in helping and supporting the authors accomplishment the research.

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