RBECT
Revista Brasileira de Ensino de Ciência e Tecnologia

Revista Brasileira de Ensino de Ciência e Tecnologia
ISSN: 1982-873X

https://periodicos.utfpr.edu.br/rbect

Animated Cartoons and Science Education: Teaching Proposal with the Animated Cartoon "Ask the StoryBots" based on the Kellyan Experience Cycle (KEC)[1]

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ABSTRACT

Animated cartoons and films in science teaching are methodological resources that can make learning enjoyable, stimulating, and meaningful for students, especially in the early years when they are having their first contact with scientific knowledge. From this perspective, this qualitative research of an applied nature, derived from a doctoral-level study, proposes the use of the animated series Ask the StoryBots in the 2st year of Elementary School through the Kellyan Experience Cycle (KEC). The proposal aims to bring scientific knowledge closer to the student's reality through the animated series and a cycle that values the student's experience. In the presented proposal, the teacher will have the opportunity to review, confirm, disconfirm, construct, and reconstruct the content being presented to the students. In this context, through the analyzed pictorial representations, it is noted that the animated series, combined with the teacher's intervention and the teaching content, significantly contributed to the construction of scientific concepts regarding the Water Cycle. In other words, the students appropriated the scientific elements that make up the content of the animation.

KEYWORDS: Constructs. Learning. Water Cycle.

INTRODUCTION

To keep up with the changes occurring in different social spheres, particularly in the context of science teaching in the early years, teachers need to address problems tied to the students' reality—problems that they can observe, act upon, and use to construct knowledge. This approach helps students become critical and reflective citizens in relation to their environment.

For this to happen, science teaching must be meaningful and presented in a clear and perceptible way, as science is intrinsically related to students' daily lives and experiences. “More than mastering content, effective teaching provides spaces for students to learn to solve problems and be participative in the contexts in which they live” (MORAES, 2011, p. 83).

It's necessary to consider different ways of constructing this knowledge so that science teaching and learning are truly significant for students. These methods must go beyond the traditional textbook, which, although an important pedagogical resource, alone does not meet the needs of this process. “There is more to teach than what the teacher can present and reproduce on boards, diagrams, slides, and blackboards [...]” (SASSERON, 2018, p. 1061). In the early years, science teaching must be even more meaningful, as students are having their first contact with knowledge, forming their first impressions of reality and the social context in which they are immersed.

Despite the importance of science education in the early years, historically, science has not held a prominent place in the official curricula for these years, often being overshadowed by Portuguese Language and Mathematics in efforts to address the educational crisis at this level of schooling. “Accustomed, often, to prioritize literacy and fundamental arithmetic operations, it is common in our schools to attribute secondary importance to natural sciences” (ABIB, 2011, p. 123).

However, even being overshadowed by other subjects, Pavão (2011, p. 15) believes that teaching science in the early years is not a difficult task. It can be simple, and the key lies with the teacher, who can leverage students' natural abilities, such as “[...] the desire to know, to act, to dialogue, to interact, to experiment, and also to theorize.”

In this context, this research proposes overcoming content-based science teaching that is disconnected from the students' reality and social context. Animated films and cartoons can be used as teaching strategies to promote reflection in science teaching on topics related to students' daily lives.

In light of the above, this article presents an excerpt from a doctoral research on the use of animated cartoons in the early years as a teaching and learning strategy for constructing scientific concepts. To achieve the proposed objectives, the research was conducted with 2st-grade students (aged 6) at a municipal school in the interior of Paraná. The episode "Where Does Rain Come From?" from the animated series Ask the StoryBots as a study object, based on the Kellyan Experience Cycle (KEC) was used.

ANIMATED CARTOONS AND SCIENCE TEACHING

In early years science education, it is essential to connect with students' daily lives and experiences to make learning meaningful, enjoyable, and interesting. This approach provides students with new experiences and a holistic education. Although science is often overshadowed by Portuguese Language and Mathematics in the early years and is sometimes presented as a subject with terms difficult for children to understand, scientific knowledge is crucial and cannot be neglected at this stage.

Rosa, Darroz, and Minosso (2019) point out that the early years are a significant and important phase of individuals' school lives. During this phase, children are eager to discover new knowledge, being curious and creative. From this perspective, early years teachers, in addition to teaching reading and writing, should develop and encourage children's critical, questioning, and observational thinking, which are linked to and supported by science. It is the teacher's responsibility to "[...] orchestrate a set of actions that encompass content and enable the development of ways of thinking, leading to the full and integral formation of children" (ROSA; DARROZ; MINOSSO, 2019, p. 157).

Animated cartoons are part of children's experiences. As a product of the entertainment media industry, they distract, enchant, and create a world of illusions and fantasies. Leles and Miguel (2017, p. 155) note that films and animated cartoons leave a mark on people's lives through their soundtracks and the messages they convey. "[...] over the years, they depict political, economic, social, and cultural issues, allowing viewers to fit into that context."

Animated cartoons influence children. Their language, colors, sounds, and music have unique qualities that touch each child differently. The world of animated cartoons is increasingly being explored by producers to understand children's desires and fantasies. "In short, there are various perspectives revealed in the relationship established with the film, whether from what it shows or does not show, or from what it suggests and makes one think" (GUIMARÃES; FANTIN, 2016, p. 145).

In the universe of animated cartoons, there are productions aimed solely at entertainment, but there are also educational productions that use play and imagination to convey information to children. In this category is the educational animated series Ask the StoryBots, the subject of this research.

When incorporating animated cartoons and films into teaching, especially in science education, teachers have access to various resources that can facilitate the assimilation and construction of knowledge. This approach can make learning more attractive, dynamic, and meaningful for students. "[...] the purpose of the film is not to teach, but this process is carried out through discussions and observations made by students with the help of the teacher during the film" (SILVA; CUNHA, 2019, p. 9).

Animated cartoons and films can bridge the gap between teaching content and students' daily lives. Silva and Cunha (2019, p. 5) suggest that using a film as an audiovisual resource "[...] aims to spark students' interest and relate the concepts covered in the classroom to everyday situations."

It is within this context that the educational animated series Ask the StoryBots is situated. The series integrates scientific knowledge into its scripts, aiming to bring this knowledge closer to young audiences through illustrations, images, and music. The American animated series was created in 2016 by Gregg and Evan Spiridellis. In 2019, it was acquired by the streaming service Netflix (NETFLIX, 2019).

Ask the StoryBots features five small robots, the StoryBots, who answer questions posed by children on a wide range of scientific topics. These include: How do our eyes see? How do people catch colds? Why is the sky blue? How do flowers grow? How many types of animals are there? Why can't I eat sweets all the time? Where does rain come from? Why do people have to recycle? How is night made? Why do I need to brush my teeth? The episodes have an average duration of 25 minutes.

With themes and questions that spark curiosity and are part of children's daily lives, the series allows the animation to be educationally addressed in the early years with the teacher's mediation. This approach connects the content presented by the cartoon to the scientific content being taught by the teacher.

GEORGE KELLY AND THE KELLYAN EXPERIENCE CYCLE (KEC)

To develop the didactic sequence using the series Ask the StoryBots, the theoretical foundation used was the Kellyan Experience Cycle (KEC), which will be presented below.

George Kelly (1905 – 1967) was an American psychologist and educator. Kelly is considered a pioneer because his cognitive theory was published in the mid-1950s, before cognitive psychology was established as a field of study.

The basic premise of Kelly's theory is the assertion that reality exists, meaning the universe is real, but each person perceives it differently. These different views or perceptions of reality are what Kelly termed Personal Constructs, different ways of interpreting and explaining the world. In this vein, Schultz (2015, p. 287), in his work on the history of psychology, describes Kelly's personal constructs: “[...] each person creates a set of cognitive constructs about the environment. By this, he meant that we interpret and organize the events and relationships of our lives into a system or pattern” (SCHULTZ, 2015, p. 287).

Thus, Kelly's approach became known as the Psychology of Personal Constructs, as the researcher investigates the constructs unique to each individual in making sense of and understanding their lived experiences. From this perspective, Moreira (1999, p. 126), based on Kelly's concepts, describes the construct as “[...] a representation of the universe or part of it, a representation erected by a living creature and then tested against the reality of that universe” (MOREIRA, 1999, p. 126).

For Kelly, the study of Personal Constructs is essential to understand why each person acts in a certain way and not in another. Constructs are the resources individuals use to predict and control their environment and actions. When constructs are used to predict immediate events, they become susceptible to changes and revisions (MOREIRA, 1999).

Based on the concept of Personal Constructs, Kelly presents a fundamental postulate of his theory and 11 corollaries that explain how personal constructs operate. “The fundamental postulate states that our psychological processes are directed by the ways we anticipate events” (SCHULTZ, 2015, p. 291). The 11 corollaries presented by Kelly are: Construction; Individuality; Organization; Dichotomy; Choice; Range; Experience; Modulation; Fragmentation; Communality; and Sociability (SCHULTZ, 2015).

According to Kelly's studies (1963), in the Experience Corollary, “A person's construction system varies as he successively construes the replication of events” (KELLY, 1955, p. 72). This involves the successive construction and reconstruction of experienced events, with a succession of occurrences and successive individual interpretations. In this context, experience is meaningful when a person lives through various events and constructs replicas of them in different ways. In Kelly's conception (1963, p. 73), it is not what happens in the event that makes a person more experienced, but rather “[...] the successive interpreting and reinterpreting of what happens, how it happens, that enriches the experience of their life.” According to Kelly's studies (1963), human learning processes in a cycle consisting of five phases, known as the Kellyan Experience Cycle (KEC), as presented in the table below.

Table 1 – Phases of the Kellyan Experience Cycle (KEC)

Phases	Description
1st Phase – Anticipation:	At this stage, the individual begins to reflect on the upcoming event, formulating hypotheses.
2nd Phase – Investment:	Based on constructing replicas of the events to be experienced, the individual seeks to invest by gathering more information in preparation for the next phase, the Encounter, in order to contribute to their knowledge construction.
3rd Phase – Encounter:	The individual engages with the event itself, having the opportunity to reflect on the ideas formed during the Anticipation and Investment phases.
4th Phase – Confirmation or Disconfirmation:	The individual is prompted to reassess previous conceptions based on the experienced event, testing their hypotheses, which may be confirmed or refuted.
5th Phase – Constructive Revision:	The individual has the opportunity to review what was experienced, with this revision potentially aiding in the formation of new knowledge.

Source: Silva and Bastos (2017, p. 747).

A lesson plan was created for the 2st-grade Science curriculum component, using the animated show "Ask the StoryBots," based on the CEK.

METHODOLOGY

This qualitative research, submitted to the Ethics Committee through process CAAE 55288921.2.0000.5547, was methodologically supported by George Kelly's (1905 – 1967) Theory of Personal Constructs through the Experience Corollary, utilizing the five phases of the KEC applied via the animated series Ask the StoryBots.

The StoryBots library includes educational TV series, books, videos, music, games, and classroom activities designed to stimulate intellectual curiosity in children aged 3 to 8 years. The themes of the series revolve around scientific questions and feature a cast of characters called the StoryBots, which are tiny, colorful robotic creatures. Figure 1 shows the opening image of the animation.

Figure 1 – Opening image of the animation Ask the StoryBots

Source: Spiridellis and Spiridellis (2019).

For the development of the lesson plan based on the KEC, the episode "Where Does Rain Come From?" was used. Data collection was conducted with a 2st-grade class from an elementary school in the interior of Paraná. Six students participated in the research, attending school in a hybrid format due to the Covid-19 pandemic. The research discusses and presents the results of three students, as they created representations in the two phases of the KEC. The study was submitted to and approved by the Ethics Committee, with the approved opinion. The lesson plan was developed following the Referencial Curricular do Paraná em Foco.

In Table 2, a lesson plan on the Water Cycle based on the KEC is presented. In this methodological proposal, learning occurs as students successively construct replicas of events (Moreira, 1999). Regarding teaching, the knowledge to be taught is also a construction system, considering that theories, principles, and concepts are human constructions, which are subject to changes, reconstructions, and reorganizations. As Moreira (1999, p. 137) emphasizes, "If human knowledge is constructed, it does not make sense to teach it as if it were definitive," meaning that since knowledge is constantly evolving, the teacher needs to develop different strategies and methods to keep up with this evolution.

Table 2 - Lesson Plan Based on the KEC

KEC Phases	Description
1st Phase – Anticipation:	At this stage, the prior knowledge of the students regarding the water cycle was verified. The students were asked questions such as: Where does the water we drink and use in our daily lives come from? Why should we not waste water?
2nd Phase – Investment:	In the second phase, students were asked to represent how they imagined the Water Cycle process.
3rd Phase – Encounter:	In this phase, the episode "Where Does Rain Come From?" from the animated series Ask the StoryBots was shown to the students. As a complement, an explanation of the Water Cycle was provided along with an experiment demonstrating how the process occurs.
4th Phase – Confirmation or Disconfirmation:	In this phase, students were asked to represent the Water Cycle process based on the content shown in the animated episode and the teacher's explanations.
5th Phase – Constructive Revision:	In this phase, the content was reviewed, and after presenting the animated episode and conducting the experiment, the students were again asked about the Water Cycle process, which elements of this process they represented in their drawings, and why.

Source: The Authors (2024).

Considering the different modes of communication possible in a science classroom and understanding how the process of meaning construction occurs for students, it is believed that the processes of signification and the formation of scientific concepts can occur through children's speech or graphic representations, expressed through their records (Moraes & Carvalho, 2015). In this study, pictorial representations created by the students before and after viewing the animated film were analyzed.

Regarding the methodology used, the Kellyan Experience Cycle (KEC) can contribute to the assimilation of scientific concepts. Through the KEC, students have the opportunity to engage with the content at different times, using their personal constructs to achieve learning, as Moreira (2015, p. 135) states:

> [...] their construction system varies as they successively construct replicas of events (corollary of experience); varying does not only mean modifying constructs but also reorganizing the hierarchy of constructs within the construction system (corollary of organization). This is all part of learning.

In this light, the use of the Corollary of Experience and the KEC is highlighted as a methodological theoretical support in the didactic intervention presented above. The next section presents the analyses of the pictorial representations. In this research, the students were identified as S1, S2, and S3.

ANALYSIS OF STUDENTS' PICTORIAL REPRESENTATIONS

The pictorial representations were created by the students based on the sequence of the KEC, using the episode "Where Does Rain Come From?" from the animated series Ask the StoryBots for the development of this study. In the episode, the animated characters visit an amusement park in the clouds to discover where rain comes from, explaining the phenomena of evaporation, condensation, and precipitation.

Considering that the objective of the research is to investigate the teaching and learning potential of the animation, the data collection lesson began with an investigation of the students' prior knowledge. They were asked to list all the words that reminded them of rain. The words and expressions mentioned were: rain, river, drops, Sun, vapor, float, sky, and drops fall from the sky.

After assessing the students' prior knowledge, they were asked to create a drawing (pictorial representation) depicting a rainy day.

In the 2nd phase of the CEK, investment, "The individual, based on the construction of replicas of events that will be experienced, seeks to invest, seeking more information for the next phase, the Encounter, so that they can contribute to the construction of their knowledge" (SILVA; BASTOS, 2017, p. 747). In this phase, the students elaborated the pictorial representations shown in figures 1, 2, and 3.

Figure 1 - Representation of the rain formation process by student E1

Source: The Authors (2024).

Figure 2 – Representation of the rain formation process by student E2

Source: The Authors (2024).

Figure 3 - Representation of the rain formation process by student E3

Source: The Authors (2024).

In Figure 1, we have the representation developed by student E1. In this representation, it is noticeable that there is no scientific relation to the process of rainfall formation. The student depicted clouds, raindrops, flowers, people, and a house, but made no association with the Water Cycle.

The representation of the Water Cycle process by student E2 is shown in Figure 2. In it, there are clouds, raindrops precipitating, and a house, yet there is no scientific resemblance to the Water Cycle.

Figure 3 highlights the representation of the Water Cycle process by student E3. Upon observing the image, it is evident that there are few elements that refer

to this process. Clouds, raindrops precipitating, flowers, a person, and a house are observed in the image. The student represented the Water Cycle process based on how they perceive the phenomenon of rain in their daily lives.

Upon analyzing the three representations, it is noted that there is no presence of scientific concepts regarding the Water Cycle process, only elements that reference this process. These representations, as previously mentioned, were developed in the 2nd phase of CEK, the investment phase, where there is an investment in seeking more information about the next phase, the 3rd Phase - Encounter. In summary, in this phase, the aim was for students to represent as much information as possible about the Water Cycle, thus preparing them for the 3rd phase of CEK, where the animated drawing about the content in question was shown, and interventions by the teacher were carried out.

Following this, the pictorial representations elaborated by the students after the release of the animated drawing in the 4th phase of CEK, Confirmation or Disconfirmation, are presented.

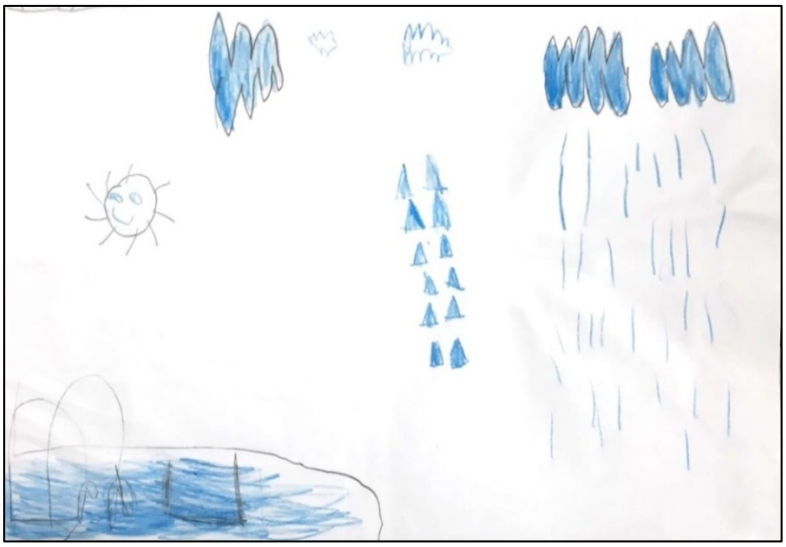
Figure 4 - Representation of the rainfall formation process by student E1.

Source: The Authors (2024).

Figure 5 – Representation of the Rain Formation Process by Student E2

Source: The Authors (2024).

Figure 6 – Representation of the Rain Formation Process by Student E3



Source: The Authors (2024).

Figure 4 is authored by student E1. It is noted that in the representation, there are elements that compose the Water Cycle process: the Sun, the ocean, clouds, rain precipitation, and the representation of evaporation, similar to what was presented in the cartoon. In light of the two representations, it is observed that the student has appropriated scientific knowledge, indicating elements that compose this process.

Student E2 created the representation in Figure 5, pointing out elements that are part of the process. The drawing includes the Sun, clouds, rain droplets precipitating, and the representation of the evaporation process, in which the student also illustrated arrows indicating water being evaporated from the sea and moving towards the clouds. Through the pictorial representation by student E2, it is evident that there was an appropriation of scientific knowledge regarding the rain formation process, the Water Cycle.

After the cartoon screening, the experiment, and the teacher's explanations, student E3 created a new representation of the Water Cycle, as shown in Figure 6. In this new representation, important elements composing this process are noted. The drawing includes the Sun, clouds, rain droplets precipitating, small triangles representing evaporation, and the ocean. It is observed through the analysis of the pictorial representation that student E3 has appropriated scientific knowledge.

Analyzing the pictorial representations created by the students, it is noted that there was progress concerning the scientific concepts presented during the phases of the CEK, demonstrating that the successive contact with scientific content at different moments, leading the student to new interpretations, contributes to the appropriation of concepts, favoring the student's learning process.

From this perspective, Hall (2007) points out that Kelly used the term "experience" to refer to the successive interpretation of events rather than the sequence of those events, meaning, "It is not what happens around him that makes a man experienced; it is the successive interpretation and reinterpretation of what happens, as it happens, that enriches the experience of his life" (KELLY, 1955 apud HALL, 2007, p. 338). In this vein, Feist, Feist, and Roberts (2015) add that experience is the successive interpretation of events, meaning the events themselves do not constitute the experience, but rather the meaning people attribute to them that changes their lives.

Kelly (1963) points out that experience is meaningful to a person when they actively engage with events, seeking to abstract, establish similarities, and regularities among them. This involvement with events will enable learning, meaning it will lead to the modification of their constructs.

Regarding science education, for conceptual change to occur, there must be a change in constructs, which can happen after the student has multiple encounters with the content being taught by the teacher. This engagement with the content can be achieved through the CEK, which comprises five phases, allowing the student to have a constructive review of the content and a possible conceptual change.

Through the analyzed pictorial representations, it is noted that after engaging with the scientific concept in different phases, notably through the screening of the cartoon and the teacher's mediation during the phases of the cycle, there was an evolution in the drawings with the presence of scientific concepts concerning the Water Cycle, meaning there was a reinterpretation of the presented content.

Regarding the cartoon "Ask the StoryBots," it contributed to the construction of scientific knowledge presented through the teacher's mediation in the five phases of the CEK. It is noted that there were similarities and regularities in the students' representations regarding the Water Cycle.

Given the above, it is understood that, when integrated with teaching content, cartoons can be significant resources in science education. Although they are produced primarily for entertainment, with the teacher's mediation, they can aid in the learning of scientific concepts.

> The use of any didactic resource in science education depends on a competent analysis of the available material that meets the objectives of educational planning. The use of audiovisual media must always be integrated

> with the course plan and not seen merely as a complement or sporadic entertainment (TRIVELATO; SILVA, 2014, p. 45).

From this perspective, it is evident that the different encounters the student had with the content about the Water Cycle enabled the appropriation of the main scientific concepts related to this process: precipitation, evaporation, transpiration, and condensation. That is, presenting the cartoon to the student in the 3rd phase of the CEK, the encounter phase, allowed the student to reflect on the ideas constructed during the anticipation and investment phases, always with the teacher's mediation.

FINAL CONSIDERATIONS

By bringing scientific knowledge closer to the student's reality, the teacher offers them the possibility to think about and transform the world they live in, contributing to the formation of critical and reflective citizens capable of acting and intervening in a transformative way in the world. This intervention is significant in the early years, as the child is in the phase of constructing and reconstructing knowledge.

One of the recurring objectives in Science education, across different practical perspectives, is the possibility and necessity for the student to establish connections between scientific knowledge and their daily experiences. In this context, the CEK can provide students with moments of reflection, the use of their prior knowledge, and the confirmation of the content. Through the pictorial representations presented by the students, it is noted that they appropriated the scientific concepts of the Water Cycle. Concepts such as precipitation, evaporation, transpiration, and condensation were present in their productions.

Working with content by starting with reflections on it, formulating hypotheses, constructing replicas, seeking more information, and providing the student with moments to review this content and the presented hypotheses helped them form new knowledge, as proposed in the CEK. From this perspective, it is noted that the CEK proposal, combined with the use of the cartoon "Ask the StoryBots" and the teacher's mediation, can contribute to a meaningful and enjoyable science education, connected to the students' experiences.

Through this research, which, as previously mentioned, is part of a doctoral study, it was noted that scientific concepts can be taught in the early years in a didactic and fun manner that is comprehensible to students, without distorting the presented concepts.

In the audiovisual field, there are various cartoons and animated films that address science targeted at children. Thus, the teacher can judiciously use these productions in the classroom, always linking them to the teaching content. These animated productions can be used as research objects so that science education in the early years is increasingly valued by educational institutions and correctly taught by teachers without conceptual distortion.

DESENHO ANIMADO E ENSINO DE CIÊNCIAS: PROPOSTA DE ENSINO COM O DESENHO ANIMADO "PERGUNTE AOS *STORYBOTS*" A PARTIR DO CICLO DE EXPERIÊNCIA KELLYANA (CEK)

RESUMO

Desenhos e filmes de animação no ensino de Ciências são recursos metodológicos que podem tornar o ensino prazeroso, instigante e significativo aos estudantes, notadamente dos anos iniciais, nos quais os alunos estão tendo o primeiro contato com o conhecimento científico. Nesta perspectiva, propõe-se nesta pesquisa de abordagem qualitativa, de natureza aplicada, recorte de uma pesquisa em nível de doutorado, a utilização do desenho animado **Pergunte aos StoryBots** no 2° ano do Ensino Fundamental por meio do Ciclo de Experiência Kellyana (CEK). A proposta visa aproximar o conhecimento científico da realidade do estudante através do desenho animado e por meio de um ciclo o qual valoriza a experiência do estudante. Na proposta apresentada, o professor terá a oportunidade de revisar, confirmar, desconfirmar, construir e reconstruir o conteúdo que está sendo proposto aos estudantes. Neste viés, por meio das representações pictóricas analisadas, nota-se que o desenho animado em questão, atrelado à intervenção da professora e ao conteúdo de ensino, contribuiu de forma significativa com a construção de conceitos científicos no tocante ao Ciclo da Água, ou seja, os estudantes apropriaram-se dos elementos científicos que compõem o conteúdo da animação.

PALAVRAS-CHAVE: Construtos. Aprendizagem. Ciclo da Água.

NOTES

1. The article was presented at the 7th edition of the National Symposium on Science and Technology Education (SINECT).

2. The cartoon was released to the public in 2012. In 2019, the streaming service Netflix acquired the franchise. In the series, which focuses on educational entertainment, five robots live inside computers, seeking answers to questions that intrigue children, taking them on a journey in search of scientific knowledge.

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Received: May 19th, 2023.
Approved: May 09th, 2024.
DOI: 10.3895/rbect.v17n2.16986
How to cite: LIMA, C. A. P.; NEVES, M. C. D. Animated Cartoons and Science Education: Teaching Proposal with the Animated Cartoon "Ask the StoryBots" based on the Kellyan Experience Cycle (KEC). **Brazilian Journal of Science Teaching and Technology**, Ponta Grossa, v. 17, Special Edition, p. 1-18, 2024. Available at: <https://periodicos.utfpr.edu.br/rbect/article/view/16986>. Access on: XXX.
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