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E^4: Professional learning for science teachers on using imaginative tools for teaching about energy

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Abstract. Faced with current environmental and technological challenges, we believe it is necessary to support and reform teacher education at academic institutions—especially for primary and lower secondary school teachers—in matters concerning energy. Here, we present the Erasmus project e^4, where we aim at (1) creating a higher education course with innovative resources for teacher training in the field of energy technologies, (2) establishing a network of academic institutions and partners from (energy) industry, agriculture and public institutions dealing practically with these matters (from hereon called stakeholders); and lastly, (3) making these results available on a web platform. In this paper, we outline the project and its contents, and report about experimenting with one of its resources, i.e. Lego® Serious Play® storytelling.

1. Introduction

This paper focuses on the project "e^4 higher Educational tools for an Embodied & creative Education on Energy"[1], a higher education project aimed at creating materials and environments for teacher professional learning in embodied narrative approaches to science teaching and learning that foster the use of imaginative forms of expression in the classroom. Five universities (Free University of Bozen/Bolzano, Italy, and project leader; Dublin City University, Ireland; University of Modena and Reggio Emilia, Italy; Nicolaus Copernicus University of Toruń, Poland; University of Valencia, Spain) and three companies (Esciencia Eventos Cientificos, Spain; InEuropa srl, Italy; and Sustainable Innovation Technology Services Ltd, Ireland) are partners in this project. The interdisciplinary expertise of the group includes general scientific and pedagogical aspects, multimedia, object-based teaching, and

[1] "e^4 higher Educational tools for an Embodied & creative Education on Energy", Erasmus+ project, cooperation partnerships in higher education, number: 2021-1-IT02-KA220-HED-000032259

augmented reality instructional practices. The working group comprises of teachers, researchers and specialists in innovative teaching methods in physics, biology, economics and engineering.

The project is structured with the help of three different but strongly interrelated tasks: (i) creating guidelines for a network of academic and private/public partnerships; (ii) developing a curriculum, composed of four modules, for teaching about energy in various fields using imaginative forms of expression; and (iii) implementing an interactive web platform to support the curriculum and the network.

The primary objectives of the tasks and of the project as a whole are: (i.) to develop and/or enrich higher education curricula (in primary and lower secondary teacher professional learning), following a teaching approach based on imaginative forms of expression (see paragraph 2.2). Among them are digital simulation to facilitate the understanding of science at primary and lower secondary school;
(ii.) to provide opportunities for students in initial teacher education to use new teaching methodologies;
(iii.) to create environments and resources for professional learning in innovative approaches to science teaching and learning; (iv.) to promote partnerships between universities and the private energy sector;
(v.) to support the strengthening of the scientific skills of EU citizens and professionals to make informed choices, use creativity and critical thinking to tackle the climate challenge.

The e^4 project is based on a narrative approach to science learning [1] and follows the basic form of understanding created when we engage in the study of natural and technical systems [2]. It allows teachers to be involved in a topic in a way that parallels the cognitive development of young students [3] and places great emphasis on the use of natural language and visual metaphorical representations for an imaginative and qualitative understanding of a scientific and technical system. The imaginative structures underlying formal scientific reasoning develop early in childhood and can be supported in their development by education. Evidence shows that the narrative approach supports learning at all levels of scientific sophistication and is suitable for students with special needs. Stories of Forces of Nature (such as Wind, Fire, Electricity, Light and Chemicals) active in natural and technical systems will be enriched with detailed scientific, technical, ecological, and socio-economic information and made more formal according to learners' level of cognitive development. The project supports the teaching and learning of energy, which is a primary educational objective and a cornerstone for students' understanding in all school levels, starting from primary school [4]. Elements of the imaginative approach have already been implemented by several of the current partners who were involved in the "FCHgo! Fuel Cell Hydrogen Educational model for schools", (www.fchgo.eu), a Horizon 2020 project that produced and tested didactic materials for introducing hydrogen fuel cell technology into primary and secondary European schools [5].

In section 2, the narrative approach of the project based on Forces of Nature, as well as imaginative forms of expression, will be introduced; and structure and content of four modules comprising subjects dealt with in our project will be outlined. Section 3 will focus on one specific imaginative form of expression, namely, Lego® Serious Play® storytelling, and present and discuss the results of a case of pilot experimentation with a group of prospective primary school teachers.

2. Narrative approach and forms of expression

The construction of a science curriculum suitable for pupils of primary and lower secondary school and consequently for their teachers should not start from the discipline as it is formalized in modern science [6]. This is a challenge for future teachers who have been exposed to the discipline using traditional approaches to school science and have not been adequately introduced to its development from a pedagogical point of view that will be respectful of the mindsets of laypersons in general and young learners in particular. In this context, the aim of the e^4 project is to offer teachers instructional materials and guidelines based upon an imaginative, narrative approach to the concept of energy that will be useful in various sciences and engineering. Importantly, the approach is based upon the general meaning of experience [7] and upon the use of imaginative forms of expression [6].

2.1 Forces of Nature

The notion of Force of Nature lies at the core of narrative science communication [1, 6]. By Force of Nature we mean a medium-scale perceptual unit or perceptual gestalt that is most easily associated with

and recognized as any form of powerful agency [1, 6]. It is important to point out that we do not use the term Force in the sense of mechanics proper, but in its primitive sense of phenomena that are endowed with power. Examples of Forces of Nature are Water, Wind, Fire, Electricity, Light, Heat & Cold, Food, Soil, Motion, etc. We capitalize these names so as not to confuse the perceptual unit (the gestalt) of a Force with its extensive aspect: electricity (or electric charge) for the amount of Electricity, heat for the amount (quantity) of Heat, or water for the quantity of Water (i.e., volume, mass, or amount of the substance water). In fact, in general, Forces of Nature are characterized by three basic attributes or aspects: (spatial and/or quantitative) extension, quality or intensity, and power. In the case of Electricity, these aspects are electric charge, electric potential, and electric power; in (linear) Motion, they are (linear) momentum, velocity, and mechanical power. Naturally, in addition to the basic attributes, a concrete Force of Nature exhibits a rich web of special relations and properties. Nevertheless, through its schematizing, metaphorical, and narrative power, our mind makes different Forces appear fundamentally similar to each other, allowing analogical reasoning to be employed [3].

When two Forces of Nature interact, or, more explicitly, when a Force that is initially tense activates another Force, its intensity drops whereas the intensity of the caused phenomenon rises (i.e., a new tension is established). Our imagination tells us that, when this happens, the first Force (the agent) passes "something" to the second Force (the patient). For example, in a windmill used for training low lying land (as is still the case in Holland), strong Wind weakens after going through the sails—its intensity drops. Consequently, Water is pumped from a low to a high pressure or gravitational level and, in turn, made powerful. So, Wind has lost "something" that has been "passed on" to Water. This "something" is energy. In interactions of Forces of Nature, energy can be made available (released) by agents and used (picked up) by patients. Moreover, energy can flow or can be transported from system to system; it can be stored in physical systems; and it can be neither produced nor destroyed (it is a conserved quantity).

2.2 Imaginative forms of expression

The agentive view of Forces of Nature is at the core of a narrative approach to science education allowing us to create and tell stories where these Forces act. Storytelling can be performed in several media making use of various imaginative forms of expression. Such forms include natural language (oral expression); sketches, diagrams, and pictures (art, visual expression); mimesis (bodily expression); building and using artifacts (for simulation); and mathematical rendering (formal expression).

Learning and understanding are expected to grow out of the interaction of direct physical experiencing (of Forces) with one or more of these forms of expression. Writing and using stories creates the opportunity for narrative experiencing [8]; designing and performing mimetic plays like Forces of Nature Theater performances allow for mimetic storytelling and the experience of embodied logic of Forces and energy [9]; and drawing Process Diagrams helps to use visual metaphors for representing our imaginative understanding of systems and processes [3].

Apart from creating simple visualizations of the material aspects of physical and technical systems, we focus on some specific imaginative forms of expression: stories of Forces of Nature using natural language [1, 10]; Process Diagrams [2] using visual language; and some forms employing bodily expressions like embodied simulation of extensive quantities of Forces of Nature [6, 9]; and Force of Nature Theater performances [6, 9]. If we generalize the idea of bodily expressions, we can enlist additional strategies and media used for engaging the imagination and fostering storytelling, namely, Lego® Serious Play® [11] and Claymation, or Clay animation [12].

2.3 Modules

The concept of energy appears not only in all the natural and technical sciences, but in social (economic) fields as well. This allows for treating different topics and demonstrates to instructors how to use our narrative imaginative approach to science in fields that appear quite different from each other. Three topics have been selected by the partnership and are currently being developed: Module 1: energy in biology, with focus on photosynthesis, ecosystems, and human nutrition; Module 2: energy in transports, with focus on cars with combustion engines, electric cars and hydrogen cars; and Module 3: renewable energy sources, with focus on Light, Wind and Biomass. A Module 0 is provided, which addresses itself

to instructors of student teachers; it includes introductory materials to the foundations of e^4 and instructions how to develop and use the forms of imaginative expressions offered in the Modules.

3. Lego® Serious Play® methodology

The Lego® Serious Play® methodology, integrated into the e^4 project through the expertise of the partner InEuropa, originated within the Lego company in response to the imperative of remaining competitive in a market increasingly dominated by video games and digital entertainment. In this methodology, the activity is guided by a facilitator who, employing a non-directive approach, encourages the individual and collective construction of knowledge, strategies, and projects among the participants. Within the corporate context, the methodology is employed to promote processes such as decision-making, assumption of responsibility, metacognition, evaluation and self-evaluation, critical thinking, and problem-solving strategies. Note that on the market there are other construction games, such as LetBricks, ARTEC© and Woma. In this article, we refer to Lego® Serious Play® because the methodology originated in the indicated company. In contexts where access to Lego bricks is not possible, other more or less structured materials can be used applying the same methodology. This study aims to transfer the methodology from the corporate setting to that of educational practice, specifically within the teaching and learning processes related to science.

3.1 The Lego® Serious Play® storytelling

The basic structure of the methodology unfolds in several steps: i. the facilitator assigns a task by posing a question; ii. participants respond by constructing a Lego model coherent with the theme addressed by the question; iii. participants verbally describe their model, engage in discussion, and share reflections on it. This basic structure has been implemented to align with other imaginative forms of expression within the e^4 project. In particular, the following phases have been defined: A) task explication; B) construction; C) narration; D) reflection.

In phase A, the teacher assigns a task related to topics already addressed in class. The teacher acts as a facilitator who fosters the emergence and development of learning through a non-directive approach. The objective of the task must be clear, precise, and shared. In phase B, students respond to the task by constructing a model using the Lego® Serious Play® tool kit blocks. This phase can be carried out individually or in groups. In the second scenario, students are invited to engage in discussion and negotiation to create a shared model. In phase C, either individually or as a group, students tell the story of the model, explicating the metaphors and its significance. Additionally, students manually animate the model. In this phase, contradictions may arise within a story or among the various stories created. Finally, in phase D, individuals or groups provide feedback on each other's creations, asking questions and offering suggestions. During this phase, further learning is negotiated, and a process of collectively constructing knowledge is initiated.

3.2 Research questions

Storytelling is a powerful tool for the organization and construction of meaning [13, 14]. We therefore intend to investigate the implications that the use of this tool, combined with modelling, has on learning the concept of energy and on prompting the prospective teachers' reflection relate to science PCK [15].

- RQ1: Is Lego® Serious® Play® storytelling an imaginative tools which promotes the understanding and the communication of content knowledge related to energy ?
- RQ2: Does experiencing Lego® Serious® Play® storytelling support prospective teachers in developing their PCK in science teaching?

3.3 Methodology, sample and data collection

At the Lego® Serious Play® workshop participated 16 prospective teachers, who concluded the Primary Physical Science Education course at the Free University of Bolzano. The students were in their fourth academic year of educational science and have already undertaken three internships in the pre-school and primary school context. The facilitator guided the students through a gradual process that allowed them to create shared animated narratives. As the initial task, students were assigned to individually construct a tree, a simple task aimed at familiarizing them with the methodology. For the

second task, students were invited to individually build a model of a Force of Nature of their choice.

The third and fourth tasks were conducted in groups, during which students modelled the interactions among different Forces of Nature. The fourth task, involved creating a shared model and a shared narrative in which Forces of Nature emerge as characters. In the next paragraph, we present the analysis and discussion of one of the story elaborated by two prospective teachers assisted by the researcher, who assumed the role of a participative observer. The research method adopted is an instrumental case study [16], because studying the particular case is instrumental in understanding something else, in this case the potential of Lego® Serious Play® storytelling for science teaching and learning. As this is a pilot study, we aim to gather insights for future developments of the research.

The data were collected through video recordings and pictures of students' creative design and production to enable a qualitative content analysis, wherein the narrative text was considered complementary to the animation of the constructed model.

3.4 Results: an animated story created by prospective teachers with Lego® Serious® Play® storytelling

The narrative begins with an initial tension where the protagonist, Fabio, is determined to understand how to reach the opposite shore of the lake to buy sacks of premium flour for his grandmother in the Country of Flour. Fabio takes his small boat and *"notices that a strong Wind passes through the country, carrying and releasing a lot of energy"* and observes that "*when the Wind passes, the boat moves but very slowly."*

These metaphorical expressions contain various schematic images through which we can understand the Wind and communicate its characteristics. The linguistic expressions refer to the intensity aspect of Wind, as its speed level is qualitatively described. Additionally, reference is made to the power aspect of Wind, to the visible effects of the Wind's interaction with the landscape. The extensive aspect of Wind, on the other hand, is not verbally expressed but through the animation of the model by the narrators who move the wind model over a specific area, also reproducing the noise it produces. The first expression used by the narrators also suggests that energy is metaphorically conceived as a substance distinct from the Force of Nature, carried by Wind and released by it.

Figure 1. In the animation of the model the Wind is depicted as moving swiftly over a specific area releasing its energy, represented by tiny Lego pieces, and transferring it to the Motion of the boat, which begins to sail across the lake.

Fabio wants his boat to move faster but does not know how to make it possible. While casually observing the leaves moving more or less rapidly depending on the Wind's intensity, he "*understands that there is a connection between the flowing Wind and the moving leaves*" and decides to build *"leaves"* to make his boat move faster. "*Fabio attaches large and enormous sails to his boat that look just like leaves."* Fabio then sets off with his boat toward the Country of Flour and awaits the arrival of Wind. *"At first […], the boat does not move; indeed, Wind is still. He noticed however that when a strong and noisy Wind passes near the boat, the boat begins to move very rapidly, unlike before when it was almost stationary."* In this part of the story, it is highlighted how the effects of Wind, hence its power, depend on the other two aspects of the Force of Nature, namely intensity and extension. Specifically, thanks to the presence of the sails, Wind now has a larger surface area to act upon compared

to before. Even in the first case, Wind was intense, but now there is a broader surface area that can "capture" it, and thus the boat will move more rapidly. In the animation of the model, the exchange of energy between Wind and the Motion of the boat is made visible. Energy is conceptualized as a substance, but this time the quantity of small Lego pieces increases: Wind exchanges a greater amount of energy with Motion. Another significant element present in this excerpt is the appearance of various levels of Wind intensity positioned between the poles of *"still wind"* and *"strong wind"*.

Figure 2. Wind moves swiftly and carries energy, represented by small Lego pieces. Wind, in its interaction with the boat, with the surface of the sails, transfers a greater amount of energy to the boat's Motion compared to the initial scenario.

The story concludes with a happy ending as the protagonist Fabio arrives in the Country of Flour and buys the prized flour for his grandmother's birthday. In this part of the story, another Force of Nature enters the scene and interacts with motion: Water. *"In the Country of Flour, there is a tremendous waterfall that flows very powerfully. The Waterfall turns a wheel connected to a mill where cereal seeds are ground to obtain flour."* In this expression, the qualitative aspects of Water are described, and the interaction of Water with Rotation of the mill wheel is narrated. Through the narrative, we can understand that the power of Water to set a process in motion, in this case, turning the wheel, depends on its quantity, or mass, and the speed at which it flows. Implicitly, Gravity also comes into play: the intensity of Water in this case is indeed considered as its distance from the ground. It is clear, therefore, that in this interaction, Water is the agent that transfers energy while Rotation is the patient, which receives the energy. The exchange of energy is not verbally expressed but through the animation of the model, which becomes a complementary tool for communicating all key concepts.

Figure 3. The Water from the waterfall transfers its energy, depicted by small Lego pieces, to the rotational motion of the mill wheel, which begins to grind the cereals.

In summary, it is evident how the concept of energy emerges in connection with that of FoN, particularly when students tell about the interaction between FoNs, like Wind, Motion and Water.

Table 1. The table highlights the metaphors (M) related to energy and FoNs underlying the story and the animation.

Energy metaphor	Energy in the animation	Energy in the storytelling
M: ENERGY IS A (FLUIDLIKE) SUBSTANCE	Energy is rendered with small Lego bricks. The bricks are identical and have an amount.	
M: FoN IS A CONTAINER M: FoN IS AN ENERGY CARRIER	Wind and Water, carry and release the small bricks representing energy. Motion receives energy.	*"a strong Wind passes through the country,* ***carrying [...]a lot of energy****"*
M: FoN IS A POWERFUL AGENT M: FoN IS A PATIENT (SUFFERING EFFECTS)	Wind moves the leaves and the boat. The Waterfall turns the wheel. Energy is released in interactions between FoNs. In this case Wind and Water are the acting FoNs. Motion is the patient FoN, which receives and uses energy.	*When a strong and noisy Wind passes […], the boat begins to move very rapidly […]"* *"a strong Wind passes through the country, carrying and releasing a lot of energy"* *"when the wind passes, the boat moves but very slowly"*
M: INTENSITY (OF THE FoN) IS A VERTICAL LEVEL/STATE	The varying intensity of the Wind is rendered through modulation of the noise and movement of the model representing Wind.	*"At first, the boat does not move; indeed, Wind is still. When a strong and noisy Wind passes near the boat […]"*

A useful tool to evaluate students' outcomes can be the Revised Bloom's Taxonomy [17] which allows to classify students' learning using categories related to six different thinking processes: remembering, understanding, applying, analyzing, evaluating, and creating. Applying these categories to students' products allows the teacher to reflect on whether the student is simply recalling facts (first level) or reorganising elements in an original way (sixth level), as in the case presented here, where students generate metaphors and develop a narrative by restructuring acquired meanings.

3.5 Prospective teachers' pedagogical reflections on teaching energy with Lego® Serious® Play® storytelling

At the end of the workshop, pedagogical reflections related to teaching energy with Lego® Serious® Play® storytelling were collected from all 16 prospective teachers. Here we report some of their comments.

Firstly, the potential of the methodology to stimulate creativity and the formulation of one's own thoughts was highlighted: "*We talked about the various creations and what was behind them, beginning to reflect on the power of this tool to enable creation with children, to provide an opportunity to invent, experiment with new combinations, and give shape to one's own thinking."* Furthermore, another prospective teacher emphasize themes such as the sense of self-efficacy and the conception of mistakes "*It's interesting to see how you can feel capable of doing something despite all the other models being different. […] It makes you feel good because you don't feel like you did something wrong […]*".

Another key element that emerged in the students' reflections was the dimension of collective creation: *"Creating the story was challenging but also enjoyable because it involved all the group dynamics. It was necessary to create a story that could be told and then find a way to tell it. I think this became possible also thanks to the atmosphere that was created beforehand: working together to create a product step by step."*

The reflections also concern the accessibility of the methodology: *"I take home how physics can become tangible and accessible to everyone through a narrative approach in which we were able to really get our hands in, build, and create a model to make physics very concrete."*

Finally, the student teachers noticed how the methodology activated processes of learning elaboration and communication: *"Through the Lego, we tried to first build the Forces of Nature, which required us to think about what the Force of Nature meant to us, what its characteristics were, and the possibilities for realizing them with Lego, and then create the story [...] Thinking about what lies behind it to represent it requires you to think deeply about what you are doing and the concepts you are discussing*."

3.6 Discussion

In light of the presented results, the Lego® Serious Play® storytelling can be considered a powerful cognitive tool that, within the realm of science education, promotes the understanding and communication of energy properties and aspects of the Forces of Nature. The findings also confirm the methodology prompt teachers' critic reflections related to PCK

Firstly, we will discuss the teacher's reflections and the participatory observations of the researchers concerning the general process. Secondly, we will deal with the results related to the story and the animation presented in the case study.

During the construction phase, the methodology involves manipulation and the use of the body in interaction with three-dimensional materials to create a model of reality. Manual activity is not an end, but stimulates creativity, memory, and the emergence of learning. The hand thus becomes the "organ of the mind" [18] in a context where learning occurs through doing [7]. In the narrative phase of the constructed model, the building blocks are metaphors for meaning expressed through narration and easily understood by participants who ask questions and provide comments.

The social and collective dimension played a fundamental role in the processing of learning. Indeed, a context of collective construction of knowledge was created [19] in which social interaction and cooperation allowed students to access the zone of proximal development [20], enabling them to perform the task autonomously. Shultz and Geither in "The serious play method using Lego bricks" [21] argue that Lego® Serious Play® has the potential to promote expansive learning [22] as it fosters collective creative processes in which contradictions emerge and are resolved through group discussion and modeling. The construction of the physical toolkit combined with the narration of the model and collective reflection on it helps participants identify the contradictions in their work; background assumptions can then be overcome through the development, whether individual or collective, of the activity. The group dimension, particularly in the phase of constructing a shared model, allows negotiation and peer learning. In the final session, the uniqueness and diversity of each model are recognized and valued, and expression is encouraged. This results in breaking down barriers and reducing the fear of making mistakes that often inhibits students from communicating knowledge. As proceeding by trials and errors implies our critical thinking and allows the progress of scientific knowledge [23], also in the teaching-learning process, error has great educational power [24]. Attention then shifts from the product to the process, stimulating metacognitive processes and self-assessment of one's learning.

In the e^4 project, imaginative tools and forms of imaginative expression, including Lego® Serious Play® storytelling, enable encountering, understanding, and communicating natural phenomena, particularly the gestalt of the Force of Nature [3, 6]. Based on the presented results, the Lego® Serious Play® storytelling has proven to be a form of expression that, by combining various imaginative tools such as modeling, metaphors creation, and animated narration, promotes learning about aspects of the Forces of Nature, their interactions, and the properties of energy. Firstly, this specific use of the Lego toolkit allows for Figure-Ground Reversal, wherein "*we switch from seeing physical objects as foregrounded figures to 'seeing' Forces as foregrounded figures acting in or on these physical objects that will need to be moved to the (back-)ground in an imaginative act"* [6]. The toolkit enables the representation and manipulation of what we cannot perceive with all senses in reality, such as electricity, motion, wind, and other Forces of Nature. The students' focus thus shifts from the real concrete object, such as the sails of a boat or the wheel of a mill, to the Forces interacting within or above technical

systems. The Lego blocks, creatively combined by participants, thus become metaphors for the Forces of Nature and their aspects.

Moreover, students delved deep into the representation of the Force of Nature, constructing and narrating its fundamental aspects: the extensive aspect, understood as spatial extension or fluidlike quantity; the intensive aspect and the tension between the various levels of intensity; and finally, the power, i.e., the effects of the Force of Nature's action on the surrounding environment. In addition, students, in their interactions between Forces of Nature, distinguished the acting Force of Nature, with initial high potential, from the patient Force of Nature, with initial low potential. Furthermore, the nature of the methodology allowed conceptualizing and concretizing energy, transferred from the acting Force of Nature to the patient Force of Nature. In the narratives and in the animations of the models, energy is understood metaphorically as a substance [6, 25] and this allows students to talk about it in the narrative and in the oral discourse, to represent it visibly and tangibly and to understand some of its properties. In particular, from the analysis of the data, understanding energy metaphorically helps teachers and children: i. to differentiate it from the Forces of Nature ii. to realize that it can be used by a patient only if it has been made available by an agent, a Force of Nature at high potential, iii. to understand that it can be stored, iv. to think of it as a conserved quantity: energy is neither produced nor destroyed. Lastly, the complementarity of model animation and verbal narration in building tangible and verbal metaphors related to the Forces of Nature and energy was significant. Through these embodied and linguistic metaphors, learning was reinforced and communicated.

4. Conclusion, implications and limitations

We have presented the e^4 project contents and given the example of a particular imaginative form of expression. Considering the results of this specific case study, the Lego® Serious Play® storytelling, to answer RQ1, can be regarded as a form of expression intertwining different cognitive tools, as it employs modeling, animation, metaphor creation, and storytelling, promoting both collective construction of learning and emotional engagement. The use of the body in manipulation and construction, linguistic expression in the narration phase, and emotional involvement throughout the process make it an imaginative methodology. This imaginative form of expression can be employed in the teaching and learning process for collective construction and communication of learning. Concerning RQ2, we can state that the methodology can develop prospective teachers' PCK, specifically the component related to knowledge and beliefs about instructional strategies for teaching science [15]. However, a more in-depth analysis and further data collection is required to more strongly affirm this thesis.

In this study, the students, through Lego® Serious® Play® storytelling, were able to consolidate their teaching and learning of the concept of energy, considered difficult to teach [26] and difficult to understand [27]. In light of the results obtained in this pilot case study, it is deemed appropriate to also consider a broader sample and analyze and gather more evidence attesting to the effectiveness of this imaginative form of expression, both for science learning and for the development of teachers PCK.

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