

# Development of Design Principles on the Planning of Didactic Sequences that use Science Fiction and Superhero Films and Series in the Teaching of Modern Physics

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**Abstract.** Traditional educational institutions are no longer the main source of scientific knowledge for students since the socio-technological transformations of the second half of the 20<sup>th</sup> century. This role goes to the most varied forms of media. Also, not all physics topics are simple to deal with in high school. Movies and series intrigue students and make them raise questions to the physics teacher. In this way, this work proposes to develop design principles on the planning of didactic sequences that use science fiction and superhero films and series in the teaching of modern physics. Four Design Principles were developed.

## Introduction

From the socio-technological changes of the second half of the 20th century, traditional educational institutions are no longer the main source of scientific knowledge for students. This role passes to the most varied forms of media [1]. This is not surprising for Brazil, a country in which the basic education institutions themselves distance students from scientific knowledge [2], with a few exceptions, showing science as something that comes from exceptional people and unrelated to everyday life [3]. Science fiction and superhero films and series are part of the daily lives of young people and are based on scientific and technological issues supporting and linking their narrative [1].

We know that not all physics topics are simple to deal with in high school, whether because of robust mathematics added to the necessary degree of abstraction [4] or because of scientific language due to its academic, authoritative, and impersonal way related to how scientific practice was composed and originated [5]. Movies and series intrigue students and make them raise questions to the physics teacher, whom will only be able to answer these questions if the student has specific knowledge about certain topics in physics or about scientific language.

In this way, this work proposes to develop design principles on the planning of didactic sequences that use science fiction and superhero films and series in the teaching of modern physics. For this, partnerships were signed with some classes of the Degree in Physics Teaching at CEFET-RJ/Campus Petrópolis to conduct an activity and plan didactic sequences.

## Theoretical-Methodological Framework

To support the activity, the use of science fiction and superhero films and series in physics teaching in Brazil an investigation was conducted through the three largest Brazilian national research events in physics and science teaching. This search revealed that there are very few modern physics teaching practices using this tool. A search across theoretical tools that would help in the analysis of scenes from movies and series was also conducted.

The methodology used in this work was Design-Based Research guided by theories of construction of didactic sequences [6], content analysis [7] and technological pedagogical and content knowledge [8].

## Findings and Conclusions

The planning activity carried out in the classes of the Degree in Physics Teaching at CEFET-RJ/Campus Petrópolis had three stages: construction, presentation, and questionnaire. The entire activity was conducted remotely, with synchronous meetings and asynchronous activities, due to the period of isolation caused by the pandemic of the new coronavirus (COVID-19).

After the analysis of the activity and the questionnaire, four Design Principles were developed.

**First Principle:** *To choose the film or series before defining the class topic facilitates the planning of a didactic sequence.* The peers that chose the film or series before defining the class topic they would plan a didactic sequence found it easier to complete the proposed activity. In the other hand, this is not always possible to do as a teacher. The topics are already set, and the chronogram is defined with anticipation. This makes the constant planning a desirable alternative, not just planning for the next class.

**Second Principle:** *It is essential to conduct regular synchronous meetings with teachers in training to address crucial difficulties regarding the definition of objectives in lesson plans.* Most of the peers could not define clear objectives in their lesson plans. For next similar activities it is advised that more synchronous meetings with the teachers in training to reinforce how to define clear objectives for a class or lesson activity.

**Third Principle:** *To watch the film or series in the classroom makes it easier for the student to engage in the related activities.* It was open to the peers to select how the film or series would be watched by the students in the activity. If it would be before or during the class. In class is easier to ensure that all students have access to the media, the right equipment to watch and time for it. Lessons with the film or series watched in the classroom has more effectiveness.

**Fourth Principle:** *Displaying only the most important scene in class allows for more time to complete the activities outlined in the lesson plan.* Even though watching the whole film or series provides better understanding of the narrative, there is only three hours per week for physics classes in Brazil. It is almost impossible to watch an entire superhero movie in one class. It makes suitable for the teacher to advise the students to watch the film or series before class and display only the scene that matters for the activity.

To conclude, the analysis of the activity showed that it was hard for the peers to articulate their pedagogical knowledge with technological knowledge and content knowledge. The activity helped them evolve in this matter, making the activity's results very satisfactory.

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