Developing Students' Interest in Physics Through the Use of Role-Play

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Abstract

This paper suggests role-play as a supplement to the traditional way of teaching science. The reasons for choosing role-play in science teaching are based upon student's interests and the competences developed through the use of role-play. The paper presents a brief introduction to the interest theory and the competences in play through role-playing along with a role-play example involving the Manhattan project and some empirical research results.

Introduction

Nowadays many people talk about a crisis in science. The crisis being that only few students are choosing to follow a career in science and in particular physics. In Denmark this has resolved in many changes in the educational system launched by a reform in 2005 in an effort to get the students more science minded. Now science plays a more dominant part in children's education especially at the upper secondary school level (Gymnasium) [1].

One of the reform changes involves the quantity of science taught to the students. At upper secondary level this results in more science teaching for all students regardless of their choice of stream and a basic level physics course is now mandatory for all students.

Another reform change is an increased focus on the students' identities and interests. One of the explicit ambitions of the reform is that science teaching needs to be more relevant and essential to all students and a criterion of success is to catch, hold and increase students' interest in science [2].

These reform changes have consequences at the teaching level as science and physics now needs to be presented to, and understood by, a larger and less homogeneous group of students with varying levels of interest in science which calls for new ways of thinking science teaching.

This paper presents some reasons for why role-play is useful in science teaching and how it affects the students' interest in science. This paper also presents a concrete example on how role-play can be used in science teaching.

1. Students' interest in science

Dewey stated in 1913 [3] that there is a strong connection between students' interest and the effort of their work. He also stated that if you

catch the students' interest you are guaranteed their attention which is a good foundation for learning.
In the mid eighties interest research had a renaissance where researchers began to define the term *interest* and its connection with learning outcome in education. According to Krapp [4] and Hidi and Renninger [5] interest is to be seen as a relation between a person and an object where the object can be a physical object, an activity, a subject etc. In a teaching situation the object of interest is usually the subject itself or a specific topic taught and the activities in the class like for example group work or lab work are seen as the mediator for the object of interest. It is also possible to regard the specific activity used in the teaching as the object of interest and the subject itself as the mediator for interest which is suggested later in this paper with respect to role-play as an activity.
Hidi and Renninger [5] categorize interest into four subsequent phases of interest: *triggered situational interest*, *maintained situational interest*, *emerging individual interest* and *well-developed individual interest.* In short the two phases of situational interest both refers to a psychological state of interest resulting from external parameters in the specific situation for example a teaching situation. Phase one refers to a short-termed interest in for example a single lecture where phase two refers to a persistent interest over an extended period of time for example several days or weeks of lectures. The two phases of individual interest both refers to a psychological state of interest as well as a relative enduring internally driven interest.
The aim of the role-play related research in this project is to unravel students' interest for science when using role-play in the science teaching and the phases of interest examined in the project are the two first phases of situational interest and whether students' interest for science develops in the teaching.

2. Role-play in science teaching

In Denmark role-play has become a very popular leisure activity for young people over the last couple or years and role-playing is now more popular to young people than more traditional leisure activities like tennis or basketball [6]. This highly suggests that there are some aspects in role-play that interest young people.
Role-play can be defined as a way of deliberately constructing an approximation of aspects of a 'real life' episode or experience, but under 'controlled' conditions where much of the episode is initiated and/or defined by the teacher [7]. More generally a role-play consists of three central elements: *a conflict* - the issue that causes a problem of some sort which needs to be discussed or resolved during the role-play, *a setting* in which the conflict takes place, and *the roles* or characters that is played by the students.
In science teaching situations creating a role-play typically means creating scenarios that incorporates a scientific conflict of some sort

which needs to be resolved by scientific experts or other involved persons.
As suggested earlier in this paper role-play might be a good mediator for interest or an object of interest in itself. Therefore creating a role-play for science teaching might be a good way of creating interest for science. Some elements that make it interesting to role-play are the experience of actively being part of a story or discussion and engaging yourself into the scenario.
When creating a role-play for science teaching it is important to be aware of the pitfalls associated with using educational games. The biggest problem is creating a role-play that is both interesting and educational at the same time so that the students also learn some science. A way of dealing with this problem is to incorporate the role-play as part of an educational program, playing the role-play at either the beginning of the program as an teaser for the content to come or at the end of the program as a highlight of the program.
A well made role-play-based educational program develops both the students' interest as well as many of the scientific competences. Gräber *et al.* [8] suggest a competence based model of scientific literacy including seven key competences needed for the students to cope with our complex world. The seven competences in their model are divided into *what do people know* including subject and epistemological competence, *what do people value* including learning, social, procedural, and communicative competence, and *what do people do* including ethical competence. In this context it is useful to use role-play to develop some of the competences which are normally undeveloped in ordinary science teaching like the communicative and the ethical competences.
When designing a role-play it is also important to choose a conflict that in some sense is relevant to the students in order to create a situational interest and personally involve and engage the students.

3. A role-play example

This section briefly[23] presents an example of a role-play-based educational program called *Dramatic Science Play* developed for the lower and upper secondary schools in Denmark. It was developed as a collaborated work between two centers at the University of Southern Denmark[24].

[23] A more thorough design description of the educational programme can be found in [9]

[24] DSP was developed in collaboration between *The Center for Science and Mathematics Education* – a center that strengthens the interplay in science between schools, university and industry and *The Centre for Art and Science* – a center that strengthens a dialogue between the world of research and the public by the use of artistic means.

The content of the educational program is the Manhattan project in relation to history and the society. As a consequence of this interdisciplinary nature of the content the involved subjects are physics, history and social studies.
The educational program is designed with the role-play in the end of the program. So before playing the actual role-play the students are first introduced to the physics, historical and social science facts needed to understand the setting and conflict of the role-play in a "classical" way of teaching. After the introduction the students work in groups preparing themselves for playing their characters. The students also prepare themselves for presenting some character-related subjects in the role-play. In their preparation the students use material which is both handed out by the teacher and posted on a homepage[25] created for the purpose.
The setting of the role-play is two imaginary meetings at the White House at the end of World War II based upon the real meetings of the Interim committee. Here the students play nine of the persons involved in the development and use of the nuclear bombs who are all summoned by the president as his personal advisors. The characters in the role-play are divided into three categories being physicists, politicians & military figures and doctors, such as War Minister Stimson, General Groves, project leader Oppenheimer and physicist Fermi just to mention a few.
Part one of the role-play takes place before the bombing of Hiroshima and here the advisors explain and discus how the nuclear bombs work, how to use them, and where to use them. The meeting ends with a letter from the president pronouncing his decision to bomb Hiroshima.
Part two of the role-play is a second meeting several days after the bombing of Hiroshima. At this meeting some of the effects and consequences from the Hiroshima bomb are presented to the students and they now have to decide whether or not to bomb Nagasaki. This part is a contra factual part where the students have the option not to bomb Nagasaki.
The educational program is ended by a discussion and conclusion phase.

4. Methods and results

The educational program was tested in 10 lower secondary school classes and 2 upper secondary school classes.
In order to encapsulate and document changes to and development of the students interest a variety of both quantitative and qualitative research methods were used. The role-plays where observed and video recorded in order to observe possible traces of occurring situational interest. Some of the students were interviewed to get a closer insight in their interests and their experience during the role-play. All of the students answered a semi-open questionnaire containing 56 questions after completion of the educational program in order to get a broad overview and tendencies of

[25] Homepage for the educational programme in Danish: http://www.dsp.sdu.dk

all the students' interests. Furthermore data was collected from teacher interviews, classroom observations and student essays.
The empirical data has still not been thoroughly analyzed therefore this paper can only present some preliminary results whereas later publications will present the overall conclusions.
Many of the students expressed that playing role-play was a *new, a different, a fun, an exciting, a challenging and an interesting* way to learn, showing their engagement and interest in the role-play. Also one of the students commented *"... at the same time it suddenly becomes interesting to read and practice the material as it was necessary for preparing your role*" expressing in a clear statement how the active preparation to the role-play resulted in a situational interest. Another student expressed how being actively engaged in the role-play affected her interest in the teaching situation by writing that *"... it gives a greater interest when you get to participate yourself ...*".
In the questionnaire the students were asked how their interest for physics was after the role-play compared to before. It turned out that about 1/3 of the students experienced an increase in their interest in physics while the rest of the students interest remained unchanged. This result is taken very positive as the students were asked how their overall interest in physics had changed.

Conclusion

Role-play designed in the right fashion seems to be a possible way to develop and maybe increase students' interest in science and also enhance their learning outcome as the students become actively engaged in the teaching situation. The students' positive attitude towards role-play in the teaching suggests that role-play should be used as a supplement to ordinary teaching of physics and science in both lower and upper secondary school.
This being said it is also important to acknowledge the limitations and pitfalls when using role-play in science teaching and always stay focused on educational purpose and learning outcome when designing a role-play.

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