

ROLE – PLAYING AS A CREATIVE METHOD IN SCIENCE EDUCATION

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Abstract. *According to a constructivist view of learning and teaching, learning science is an active process in which students construct their own understanding of the life events. Role-playing activities are not very used in science education, although, in cultural education or in social disciplines, such methods are of big interest mostly because they help students to understand things from the perspective of another person.*

This study explores teaching the structure of matter and abstract physics phenomena topics using role-playing activities. Its aim is to demonstrate that role-playing activities may be a powerful and creative tool in science classrooms and argues for their usefulness in the understanding and teaching of abstract phenomena.

Following topics are presented within this study: descriptions of activities, the reactions of the students to this way of instruction and analysis of some role-playing activity design that help students to develop their intuition concerning abstract complex systems. It is also analyzed how this experience can be used in teaching and how it can make teachers aware of the way students learn, if students are conscious of their own learning activity and how students evaluate their understanding of the learned material from the perspective of the future teacher.

Due to the fact that role-playing is an interesting, agreeable and motivating way of engaging the student in the activities that are to be presented in classroom and that through it ideas can be sketched or debates take place, we consider that these are reasons enough to include this method in the didactic repertoire of the future science teacher.

Keywords: *physics education, creativity, role-plays*

1. INTRODUCTION

The Oxford English Dictionary defines role-play as: “Noun the acting out of a particular role, either consciously (as a technique in psychotherapy or training) or unconsciously (in accordance with the perceived expectations of society)”. The term “role” comes from the “rolled-up” script actors used to use over two thousand years ago in Ancient Greece. In time, the script became the part, and actors then were said to play the “role” of, say, Hamlet or Othello or Ophelia or Desdemona [1]. Jacob L. Moreno (1889-1974) sought to revive theatre by inviting the actors to improvise, and his early “Theater of Spontaneity” in 1921 became one of the first “improv” troupes. By the late 1940s role playing had become a recognized part of business, community, and other forms of the budding field of what was to become organization development. In the 1970s it was widely used as part of behavior therapy for assertion training and social skills training. It has been known as a method in education since the late 1940s, but there were enough problems with its use that it hasn’t fully “caught on” [1, 2].

Role playing is derived from psychodrama that may be used to help students understand the more subtle aspects of literature, social studies, and even some aspects of science or mathematics. Further, it can help them become more interested and involved, not only learning about the material, but learning also to integrate the knowledge in action, by addressing problems, exploring alternatives, and seeking novel and creative solutions [2, 3]. Role playing is the best way to develop the skills of initiative, communication, problem-solving, self-awareness, and working cooperatively in teams, and these are above all--

certainly above the learning of mere facts, many if not most of which will be obsolete or irrelevant in a few years--will help these young people be prepared for dealing with the challenges of the Twenty-First Century. [2]

In science education role play can be seen as an interaction between play, games and simulations and the student that performs an activity with learning outcomes [2]. Using this method, the teacher encouraged the student to be intellectually and also physically involved in the lesson content and that facility his understanding of difficult concepts [4].

There are many advantages for learning science through role play. Role-play [3, 5, 6]:

1. encourages students to create their own reality;
2. develops the ability to interact to other people;
3. increases students motivation;
4. engages shy students in class activities;
5. makes students self confidence;
6. helps students to identify and correct misunderstandings;
7. is agreeable and fun;
8. shows students that the real world is complex and problems that appear in the real world cannot be solved by simply memorizing information;
9. underlines the simultaneous use of different skills (acquired separately).

There are other reasons why role-play can be considering a valuable didactic method [2, 3, 5-7]:

1. it give students an understanding of their own learning by creating their own role-plays;
2. can teach about ethical and moral issues arising from the science curriculum;
3. it helps students to recognize and interpret their place in the world;
4. it gives to the students a chance to experience life events in a physical way (more appropriate to their own learning style);
5. analogical role play can help students to conceptualize.

Role Playing as Simulation in science class

Role playing is simply a less technologically elaborate form of simulations. Teaching salespersons to deal with customers, teaching doctors to interview patients, teaching teachers to deal with difficult situations, all these require some measure of actual practice and feedback [6].

There are five categories of role-play that can be used in science classes: investigations, games, presentations, analogy role play and simulations [8].

Table 1. Role playing activities used in science classes

Role-play category	Role-play exercises	Age	Suggested activity	Examples of science curriculum applications
Games	Memory games	10-	Asked student to remember everything that was on the table after locking it for ...minutes	Physics apparatus, Physics terms, Fuels,
	card games, card cycle	10-	Students work in groups to organize information cards	Cyclic aspects in science: water cycle, decay cycle,
	10 questions	10-	Stick a word or picture label on student's backs. They can ask 10 questions to guess what is written. They work in pairs and answers are limited on yes and no.	Types of forces, electromagnetic spectrum, atom structure.
	cut-and-stick	10-	Worksheets containing information's (words, pictures, phrases) which students cut out and arrange in the correct order	Electrical symbols
Presentations	Learning and presenting science	14-	Groups of students read, analyze and present scientific content.	Sources and properties of alpha, beta and gamma radiations
	science play	12-	Groups of students prepare short or extended plays about science, scientists, invention,	Life histories of scientists e.g. Faraday; History of science discoveries, histories on inventions, effects of science in society
	child in role	12-	A part of a lesson	Atomic models, electrical circuits,
	Radio commentary	14-	Individuals or group of students plan a talk using scientific skills	Energy resources of the future, Pollution and how it affect our life,
Investigations	Experiments and investigations	12-	Individual or group experiments	Electromagnetism,
Analogy role-play		14-	Using children as objects or elements of scientific theory	states of matter; electric circuits, chemical reactions [2]
Simulations (in physics)	Interactive collaborative problem-solving	12-	simulated meetings, debates, web-based role-play simulations	use of nuclear fuel (debate); alternative energy resources

2. METHOD

Role playing can be an individual or collective activity. During the Didactics of Physics course and seminary, I practiced at least three types of role playing that are presented in the following.

1. A simple role playing activity

Activity 1. (adapted from [2])

I divided the students into groups having the following roles:

1) interrogators: based on the course and the discussions afterwards, the students must write a list of at least three questions they want to ask;

- 2) assistants: identify at least three situations / information they consider relevant and explain why;
- 3) muddy pointers: identify at least three situations that must be clarified;
- 4) example givers: highlight through at least three examples that they can apply with efficaciousness the information learned during the course;
- 5) quiz makers: address at least three questions based on which they can evaluate the amount of information acquired by their colleagues during course;
- 6) competence verifiers: indicate at least three connection point between the taught material and the general competences of the course.

The students consulted themselves during online discussions in order to formulate answers, thus analyzing and debating the taught material regarding its contents and the technique used to transmit information. The transition to a new theme can be done in previous class, discussing the materials (questions, answers) presented by the students.

II. Complex activity in stages:

1. Situation/problem to investigate/resolve exposition

Two main themes are proposed for debate during seminar.

Activity 2. Teaching the lesson “Archimedes’s law” at gymnasium

Activity 3. Teaching a synthesis theme related to “the structure of matter – aggregation states – object dimension”, using role playing. In this case, the groups are advised to address the problem considering the level of the audience.

2. Material (Scenario) investigation and organization

The role play can be either instructor guided or student guided.

These two types of role playing are presented to the students, who choose the student guided approach with the observation that the teacher can intervene as moderator, facilitator or guardian during feedback or even during the role play activity (if necessary).

Activity 2. The students are divided into groups and go through the following steps:

- a) study the Physics Program (Schedule), alternative manuals, methodological guidebooks and determine the scientific content of the lesson that is to be presented
- b) use the material from the pedagogy or didactics class, information acquired from the teachers and mentors and other material found online, they determine the didactic scenario
- c) search together for the best methods to evaluate the proposed operational objectives.

Activity 3. In this case, using the brainstorming method, personal experience, information from the bibliography given by the teacher, online information or even through discussions with colleagues not involved in the didactic module, the students:

- a) identify the information that is to be presented adapted at the audience level
- b) search for role playing examples that they might use, in the indicated bibliography [6-8]
- c) determine the activity structure: course, seminar, workshop, interactive presentation, etc; time allocated; objectives; the way in which feedback will take place.

In the instructor guided role playing case, the students are given written material about the theme, organization mode and implementation (scenario) (example 2), in order for them to organize the role play based on this information.

3. Role playing itself

In the case of example activity 2, the students choose a representative from each group to teach the lesson, the other students trying to behave like gymnasium learners. The students

are divided into groups during the lesson, each group having a specific role like in example activity 1: interrogators, assistants, muddy pointers, quiz makers and competence verifiers. Teaching time is 30 minutes, followed by discussions based on the questions and answers presented by the working groups.

In example 3, three ways to address the theme in groups based on age, are displayed, the used role plays are presented and debated every student being actively involved.

4. Reflection

Students are asked to assess their learning in terms of course content, teaching or research skills and technology use. They reflect on the course learning objectives as well as the advantages or limitations of the teaching method.

From the perspective of the future teacher, it is analyzed how these experiences can be used in teaching and how it can make teachers aware of the way students emotional learn, to what degree students are conscious of their own learning activity and how students evaluate their own understanding of the learned material. The evaluation was done by letting the students complete an anonymous questionnaire at the end of the period in which the method was applied. The ten questions are presented in table 2.

Table 2. The anonymous questionnaire fulfilled by students

No.	Question
1.	Did you like creative role playing activities? Why?
2.	Do you prefer science learning and teaching with or without role playing?
3.	What role playing activities did you like the most? The least?
4.	Do you like science learning and teaching more after these activities?
5.	Did you adopt some of the role playing techniques in your future teaching activities?
6.	Do you spend more time to design a role playing scenario?
7.	Do you need to have more knowledge about the temper, learning style and intellectual level of the students to engage them in the class scenario?
8.	Do you consider that these activities are easier or harder to control?
9.	Do you consider that these activities are generally valuable or must be adapted to the audience?
10	Other comments

Also, the students attendance at the courses and seminars, their active participation and their perception about what are the duties, the required knowledge and the expected feelings of a teacher, were monitored.

To evaluate the students' performance and to differentiate from sessions with and without role-playing activities, I used a scale from 1(lowest) to 5(highest) for:

- | | |
|---------------------------|-----------------------------------|
| a) Active presence | e) Students confidence |
| b) Cooperative group work | f) Students communications skills |
| c) Creative performance | g) Students responsibility |
| d) Scientific knowledge | h) Students' leadership skills. |

I compare me results with student's opinions by giving them a second questionnaire to find their accord degree with the statement: "Role-playing activities in science classes has effect on the development of students: interpersonal abilities (b), creativity (c), scientific knowledge (d), confidence (e), communications skills (f), responsibility (g), and leadership skills (h).

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3. RESULTS AND DISCUSSIONS

The three activities took place during the Didactics of Physics course and seminar (from 2007/2008, 2008/2009 respectively) with the average attendance of 12 students.

Example activity 1 was applied in several themes and we can mention one of them, "Teaching methods of direct exploration: the experiment". The students participated at lesson simulations in which these types of experiments were used, after defining, classifying and methodically describing the demonstrative experiment and the real experiment. All implicated groups, namely: interrogators, assistants, muddy pointers, example givers, quiz makers and competence verifiers, exposed their questions, examples or identified situations according to their role, after all these activities took place. The questions were well addressed, the assistants being the only group having difficulties in expressing their opinion. After discussions, the need to explain the differences between the demonstrative experiment and the real one was sensed. We can mention some of the interesting questions that the quiz makers used to test their colleagues, like: What can students learn by undertaking a demonstrative experiment? How can computational experiments and simulations be integrated in an experimental lesson? What kind of experiments will be used in the physics lesson 20 years from now?

As a result of example activity 2, a differentiated approach of the theme could be observed, beginning from a simple transmission of knowledge, learning Archimedes's law through experiments, and ending in a causal approach of the subject where the prior knowledge of the students was exposed. Although the subject was addressed in different ways, a close similarity of the proposed operational objectives was observed. All the participants are asked to complete the anonymous questionnaire presented in table 1.

After the student's answers were analyzed, the following conclusions related to the training for and the ongoing activities were drawn:

1. the more active the method used, the more time required to prepare the scenario;
2. the more active the method used, the more harder became having the control over the activity;
3. the ongoing of the lesson could be only partially controlled using the prepared authentic didactic scenario;
4. even though the information presented was limited, a consistent prior knowledge was needed in order to fully understand it;
5. the more knowledge about the temper, learning style and intellectual level of the students was available, the more engaged the students were;
6. in developing lessons, the teacher must adjust the teaching style and methods to the audience.

During the example activity 3, additional aspects could be observed:

1. the degree of abstraction grows with age, but the creativity in developing exercises declines;
2. although the activities that are to be held in gymnasium and high school were taught "in aquarium" (the learners were also students), the students were much more interested in the explanations.

The role play activities presented were those from literature and we were not interested for the moment in developing new plays, but only in observing the reactions to the application of this method, the specific elements, the way in which the students consider to have learned the contents, etc. It was observed that abstract phenomena like electricity, the structure of matter and different aggregation stages are more suggestively presented using

“child in role”. After the monitored of the student’s active participation at the courses, and their investigated skills we obtained the data given in Table 3.

Table 3. Results obtained after students observation (12 students /promotion)

No.		2007-2008		2008-2009	
		Activity with role-play	Activity without role-play	Activity with role-play	Activity without role-play
a	Active presence	4	3	4	3
b	Cooperative group work	5	2	5	2
c	Creative performance	4	1	3	1
d	Scientific knowledge	4	4	2	2
e	Students confidence	4	3	3	3
f	Students communications skills	4	3	4	2
g	Students responsibility	4	4	2	2
h	Students leadership skills	4	3	4	3

A statistical representation is given in the Fig. 1.

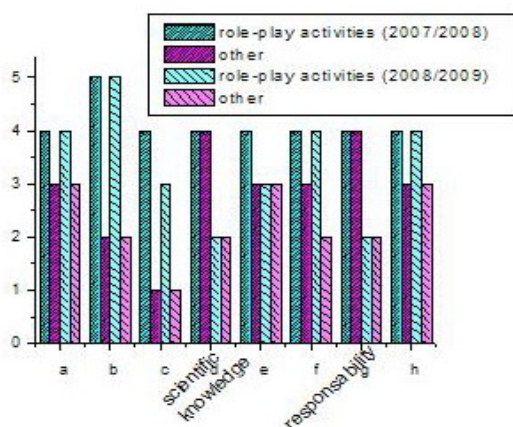


Fig. 1. Statistical analysis of the students activity, knowledge’s and achieved abilities after this learning session

We observe that students were more actively involved, more creative and confidence in these activities. Also they used more cooperative group work to solve their problems that implies communications and leadership skills. We notice that students responsibility and developed scientific knowledge where the same and depends on the students promotions (2007-2008 and 2008-2009).

I compare these results with the students answers related to their accord degree with the statement: “Role-playing activities in science classes has effect on the development of students: interpersonal abilities (b), creativity (c), scientific knowledge (d), confidence (e), communications skills (f), responsibility (g), and leadership skills (h).

The results obtained after data collection and systematization, per item (b-h) and hierarchically, from “agree”, “partial agree”, “partial disagree”, “disagree” and “I don’t know” are presented in Table 4.

Table 4. Results obtained after students answers (24 students from two promotions)

No.		“Role-playing activities in science classes has effect on the development of students.				
		Agree	Partial agree	Partial disagree	Disagree	I don’t know
b	Cooperative group work	8	10	3	2	1
c	Creative performance	10	6	4	2	2
d	Scientific knowledge	6	8	3	-	7
e	Students confidence	8	8	2	1	5
f	Students communications skills	10	8	1	2	3
g	Students responsibility	6	8	3	2	5
h	Students leadership skills	10	6	3	3	2

A statistical representation of their answers is given in Fig. 2.

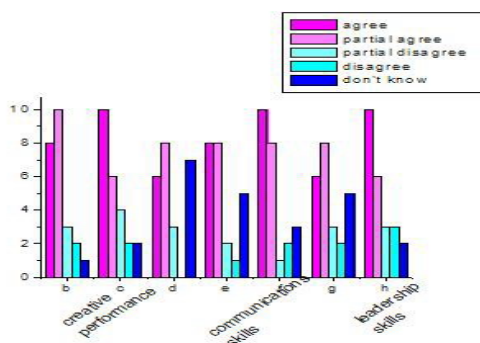


Fig. 2. Statistical representation of students' answers per item after the learning session

The students consider that role-playing activities contribute mostly to the development of creativity, communications and leadership skills. We observe that some of them don't know how this kind of activities produces scientific knowledge or can improve their responsibility in learning and confidence. I consider that these answers are realistic because students have few or non teaching experience and all the answers were given from their learners experiences.

4. CONCLUSIONS

In this study we present student role playing activities, student reactions to this teaching method, an analysis of some role-playing design that helps students to develop their intuitions concerning real life or abstract phenomena.

We showed that from the perspective of the future teacher the experience of a role play can increase the learning motivation; it actively and consciously involves the student in activities, and determines the teacher to be aware of the temper, learning style and intellectual level of the students; it improves the personal evaluation of understanding the received information. On the other hand, role playing is interesting, it's fun and causes students to interact. Through this method we develop skills and abilities like responsibility and leadership in learning, peer learning/teaching, group work, confidence or creative problem solving that would be difficult to develop using traditional teaching techniques.

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