

Molecular Skit- Role-play as a Pedagogical Tool for Teaching Molecular Biology as an Under-Graduate Engineering Course

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Abstract : Role-play is an exercise in which the participants assume certain roles of characters, collaboratively create stories and act-out the roles in character on stage. Role-Play is being practiced as a pedagogical approach since years and has been found to be effective in teaching history, economics, social sciences and engineering subjects as well. The present study discusses a similar effort of group role play practiced for teaching Molecular Biology course for under-graduate students of Biotechnology. The purpose of the Role-Play- Molecular Skit was to enhance the temporal and spatial learning of some selected concepts of Molecular Biology course. The topics chosen were relevant to learning and formed the corner-stones of the course. The exercise comprised two phases- technical script writing and acting-out.

The concept of story-building model related to the topic along-with the technical aspects was adopted for script writing. The contents of the scripts were reviewed for essential technical features, effectiveness and feasibility for acting-out. This was followed by assigning the roles amongst the group members and acting-out the concepts on stage. Assessment for the activity was based on appropriate rubrics which were mapped to Graduate Attributes, Global outcomes and Performance indicators. A formal written feedback collected from the participants showed that the activity was a new experience, enhanced the understanding of the concept, sensitized their creativity by story building, honed their writing skills and reinforced their confidence of acting on stage. The activity was thus instrumental in enhancing the learning, improving the communication skills and bringing-in a concerted team effort on stage.

Key words: Role-Play, Technical script, Act-out, Communication skills

1. Introduction:

A. About Role Play

Role playing is an active method of learning process wherein the students assume the role of some assumed character and play the role.. The Oxford English Dictionary defines role-play as: "Noun- the acting out of a particular role". Role-playing is being used as a pedagogical approach for many years, predominantly

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in teaching history, sociology, political science, medicine and off late, mathematics, science and technology. disciplines. Role playing helps students to understand the subtle aspects of the subjects and keep the students involved and interested. It helps to integrate the knowledge in action, exploring alternatives, and explore creative approaches for learning. [1].

Utilizing, Role-playing uses the techniques of drama teaching is a holistic teaching method that inculcates the process of critical thinking, instigates emotions and moral values, and informs about factual data. It has been found that role-playing teaching increases the efficacy of the learning experience and makes it more grounded in reality (Pierce & Middendorf, 2008). In many of the Universities, as part of meeting the Graduate Attributes, the students are encouraged to participate in team-work, demonstrate articulation and leadership traits. A mentor often steers and monitors the progress of the team activities to ensure effective implementation, equitable distribution of workload amongst the students and avoid any possible conflicts [5].

Role Play assumes significance in the context of teaching the complex abstract ideas. Craciun (2010) explored Role Play for teaching the structure of matter and abstract physics phenomena. usefulness in the understanding and teaching of abstract phenomena [3].

B. Significance of Role Play in Molecular Biology Course

Learning can be sometimes difficult for students where a one-way mode of flow of information from teachers is practiced and institutional pressures such as standardized tests and inflexible curricula push teachers and students into rote exercises. At times this may lock the communication between teachers and students into rote exercises. This may lead to spiraling withdrawal and alienation on the part of students. In such "passive learning" environments, students tend to mechanically write down the material but rarely reflect on it. In this context, Role-playing assigns students to think, argue, write and/or behave as if they were a particular person in a particular situation [2,4].

C. Pedagogical Advantages of Role Play

The dynamic communicative interplay generated through role-playing exercise has a significant

pedagogical advantages. The role-playing exercise stimulates students' involvement and enhance the learning environment [9]. Intensive student participation affords unique learning opportunities to students and enhance their communication skills. [6]. By encouraging experimentation, role-playing helps students discover divergent viewpoints and overcome stereotype mod of learning the concepts as they examine subjects from multiple perspectives [8].

D. Stake holders, Courses and Topics Selected:

The sample consisted of 48 students of B.E. (Biotechnology) program belonging to IV semester of KLE Society's B.V. Bhoomaraddi College of Engineering and Technology, Hubballi, Karnataka. The course instructor, students performers and student audience were the various stake-holders in the role-play exercise. The learning from the role-play was presumed to happen at three levels, highest at course instructor, followed by performers and student audience.

The course selected for the role play was Molecular Biology for IV semester (Biotechnology). The students were formed into groups of four members each. The topics for the activity were chosen following interaction with the students in the classroom, considering the interest of the students, ease of performance and relevance. Table 1 shows the topics chosen for the activity and rationale for selecting the topics.

Table 1 Topics Chosen for Role Play and the Rationale for Selection

Sl. No.	Topic	Rationale and Significance
1	Messelson and Stahl Experiment	Proved the hypothesis of semi conservative replication of DNA
2	DNA Replication	Central to the understanding of Molecular Biology
3	Tumor Suppressor Genes	Genes involved in controlling the cell cycle and preventing cancer
4	Transcription and its Inhibition	Part of central dogma of life & involved in mechanism of drug
5	DNA Mutations	Changes in genes leading to evolution and involved in genetic diseases
6	Apoptosis	Programmed cell death & significant in processes ranging from emryogenesis to ageing
7	Lac Operon	Model for studying inducible positive gene regulation
8	Griffith's Experiment	Demonstrated the principle of genetic transformation in bacteria
9	Avery, McLeod Experiment	Supported Griffith's experiment and proved that the transforming factor was DNA
10	Trp Operon	Model for studying Repressible negative regulation of gene
11	DNA Repair Mechanism.	Insights into the mechanism of reversing the DNA damage caused by mutations

2. Methodology:

The activity was designed into two phases:

- 1). Character sketch of technical concept and
- 2). Enacting.

A. Character sketch of technical concept :

- 1). Technical Sketch:

As part of first phase, the students were made to draft a write-up of the topic assigned. It was designed on the theme of story-building around the concept and gradually introducing the concept to the audience. The characters of the sketch assumed different roles and an approach to elucidate the technical aspects of the topic was done. The draft was reviewed in consultation with the course instructor and modified wherever necessary.

- 2). Enacting:

After the character sketches were completed, as part of second phase, acting-out of the script was performed. Role-play participants were ready to move from the realm of written script to the stage of performance, where students engaged in simulated dialogues with each other, working to act-out the concept that matched with their character sketches with the inherent creativity built in the form of play in the light of technical content of the topic [7].

The activity started with the brief introduction and students performing their assigned roles. Each group performed within a time frame. Appropriate costumes and supporting properties like labels and other aids were made use of for effective delivery of the role-play. The take-away message of the concept was made clear at the end of each performance. Usage of proverbs and sayings in English and vernacular were encouraged to elicit the inherent creativity and effectiveness.

B. Casting the Character- A case-study of DNA Mutations Experiment:

1. One of the group member among the four would be moving on the stage in an unusual way and is showcased as an alien. Upon interrogation by another member he narrates that he was an ordinary man but had become so due to a process called Mutation.
2. The story unveils as he narrates about Mutation . The members would be wearing placards with A, T, G,

C written on both sides.

3. The different types of mutations (Transition, Transversion, Base-pair, Frameshift due to Insertion or deletion, Non-sense) are demonstrated on the stage with the appropriate changes being made in A,T,G and C by overturning the placards.

4. The oral briefing the events goes in tandem and finally the play concludes with all members underscoring the significance of mutations as raw material in evolutionary process.

C. Role Play in the context of Outcome Based Education (OBE):

Outcome based education is student centered instruction system which focuses on measuring student performance i.e. outcomes. Outcomes include knowledge skills and attitudes [11]. Graduate attributes form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practise at the appropriate level. Graduate attributes are clear, succinct statements of the expected capability, qualified if necessary by a range indication appropriate to the type of programme. They are exemplars of the attributes expected of graduate from an accredited programme [10]. The present work addressed some of the Graduate attributes defined as shown in Table 2.

Table 2. Graduate Attributes, Global Competencies and Performance Indicators addresses by Role Play Activity

Graduate Attribute (GA)	Global Competence	Performance Indicator
GA1:Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.	Demonstrate the competence in basic sciences	Apply laws of natural science to an engineering problem
GA 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	Demonstrate an ability to form a team and define a role for each member	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
GA 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	Demonstrate an ability to comprehend technical literature and document project work.	Create <i>flow</i> in a document or presentation -a logical progression of ideas so that the main point is clear
	Demonstrate competence in listening, speaking, and presentation	Deliver effective oral presentations to technical and non technical audiences -

The character sketching and enacting of the Role Play was assessed according to the Rubrics framed for the purpose.

Table 3 and Table 4 show the Rubrics formed for the assessment of the activity. Table 3. Rubrics for Assessment:-Technical Sketch

Trait	Exemplary	Satisfactory	Unsatisfactory
Technical Content	- Biological concept of topic covered completely - Good story building - Use of proverbs/contextual references	- Biological concept not fully covered - Average story building	- Biological concept lacking clarity - Role-play context not in alignment with topic chosen

Table 4. Rubrics for Assessment: Enacting

Trait	Exemplary (65-100 %)	Satisfactory (34-65 %)	Unsatisfactory (0-33%)
Dialogue delivery	- Clarity & fluency of speech - team coherence	- Average clarity & fluency - Moderate team coherence	- Lack of clarity & fluency - Moderate team coherence
Stage usage - properties/costumes	Optimum use of stage space, background sketches, aids/costumes	Average use	Totally lacking and regardless of stage and costume usages.

D. Response Survey and Questionnaire for Role Play Course Activity

A formal course survey from the student participants was collected to assess the effectiveness and identifying areas with scope for improvement. Following is the model of questionnaire framed for the survey

1). Was Role play a new experience of learning or had practiced earlier?

2). As a participant in Role Play, the understanding of the concept

a). Increased significantly b). Increased c). Remained same d). Reduced

3). How did the following help in enhancing the learning curve:

☐ Technical Script writing:

☐ Enacting on stage:

4). The difficulties encountered while:

Writing script and assigning role-

Enacting on stage:

5). The support and guidance of the Course-instructor was:

a). Very good b). Good. c). Averaged). Poor

6). Suggestions for making the Role Play concept a more effective teaching-learning process:

☐ Marks allotted

☐ Time for enacting on stage allotted

☐ Interactions of course-instructor- Student groups

☐ Choice of topics

☐ Group formation

☐ Costumes

7). Any other comment/suggestions regarding the activity for improvement.

A total of twenty four students respondents were chosen randomly for collecting the feedback. The feedback survey showed that it for all the twenty four students, Role Play was a first of a kind of experience as a learning method. Fifteen respondents opined that their understanding of the concept increased significantly, while eight felt it increased and one expressed it remained same. The written and oral communication skills were put to test and helped them in honing the same. Some students felt there was difficulty in story- building appropriate to the topic. Many opined that there was more scope for using properties to enhance the effectiveness. Some respondents expressed their encountered problems in co-ordination of dialogue delivery on stage. A need for hand-holding for writing the scripts by the course-instructor and a formal rehearsal was felt by few respondents.

Table 5. Students' Response to Role Play as a Pedagogical Tool for Molecular Biology

Sl. No.	Response
1	It was a new method of learning experience for all the students
2	It increased the depth of understanding the concepts played by them.
3	Drafting technical script enhanced the writing skills and provided an opportunity for story-building exercise
4	Enacting helped them in improving communication skills and public. It enabled temporal understanding of the events underlying the concept
5	Scope for improvement existed in terms of use of properties and costumes
6	A need for mock rehearsal was expressed

3. Conclusions:

The role play was instrumental in enhancing the learning of the concepts and honing the communication skills. It also provided the students with an opportunity to build a story out of a theoretical concept which was hitherto not practiced. The exercise provided the students an opportunity to get engaged in active learning, a way different from traditional approach. The activity instills creative thoughts, motivation to learn and understand team dynamics.

The role-play concept for Molecular Biology course was a overall new experience of teaching-learning process for students and teacher and held scope for improvement for further enhancing its effectiveness in the forthcoming practices.

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