



ADAPTING FORCE CONCEPT INVENTORY TEST INTO DRAMA APPLICATIONS

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Abstract

In general, students complain about abstractness of physical concepts and attribute their failure on it. It is most common problem that we also face with in college classrooms. Even though their concrete and direct experiences in their daily life, e.g. motion, they are not aware of how physical laws operates in their lives. At this point, role-play activities become more evident strategy to teach such subjects because of their ease of dramatization. Seven students enrolled in physics education program voluntarily participated in the study. For this study we selected Force Concept Inventory, which is illustrated with clear representations of everyday situations. Questions in the inventory were used as a guide to develop role play activities. We believe that these activities will encourage physics teachers to use them in their instructions and also develop new ones. Students will get benefit from visualization of the physical situations to discuss in classroom environment, which may lead to better understanding.

Keywords: Force Concept, Role-Play

INTRODUCTION

Misconception literature in physics education shows that students do have difficulties to learn fundamental concepts in physics, where students start to perceive science as challenging to deal with. These difficulties should be considered by teachers firstly for diagnostic purposes and secondly for preparation of lecture design to remediate those. It is not surprising that poorly written textbooks by authors which are not aware of possible misconceptions in units, usage of the key terms of scientific concepts differently in real life situations, and even in-service teachers with alternative conceptions lead to form difficulties in students' understanding. We could list also students' own observations in real life situations as a source of conflict with scientific knowledge, therefore a source of alternative conceptions (Halloun & Hestenes, 1985).

To be able to make visible these ideas, there is various kind of misconception tests developed as diagnostic instruments such as a popular one; Force Concept Inventory (FCI). FCI is developed by Hestenes, Wells and Swackhamer (1992) that includes six categories of misconceptions as follows: (1) kinematics, (2) impetus, (3) active force, (4) action/reaction pairs, (5) concatenation of influences, and (6) other influences on motion. For this study we chose to use FCI to guide us to highlight the addressed misconceptions in questions. We did not focus on diagnosis of conceptions

but by directly referring to questions in FCI to provide an instruction to handle misconceptions.

Drama in Classrooms

Drama has been applied in different grade levels with distinct scopes as a method or a strategy integrated in a lecture. Mainly the thoughts about drama is inclined on it is preferred in instructions for younger age-levels. We believe that in higher grades traditional methods do not work efficiently because of the dominance of the abstracted concepts in physics that is why learning becomes harder. But drama-based instructions facilitate an environment where students actively take roles to improvise their own understanding (San, 1996). Meanwhile, abstracted ideas become concrete play via activated imagination within drama. It also provides communication among peers, where students express their own experiences and get benefit from others (Southwell, 1999). Taking into consideration the positive effects of drama, for the study we had decided to dramatize the FCI questions with role-play and usage of the daily materials that we use.

METHOD

The instruction on drama and FCI was completed with seven students. All of the participants are pre-service physics teachers at Secondary Science and Mathematics Education department in Middle East Technical University in Turkey. Firstly, students are introduced with FCI questions. Accordingly, they were expected to dramatize the questions. By taking students' difficulties into account, pre-service teachers figured out more clear vision and better understanding of the situations given in the questions. Each role-play was photographed piece by piece. Immediately after, all of these dramatizations were reviewed by the participants for any possible mistake. In the *Findings* section, questions numbers from FCI were reported with the question information and developed role-play parts by students.

FINDINGS

FCI questions were articulated by teacher candidates according to their appropriateness for dramatization. Instead of reporting each question one by one, we preferred to group the products into six main themes. These are as follow: (1) friction force, (2) hit and motion, (3) velocity, (4) pushing "action-reaction pairs", (5) falling down, and (6) circular motion. In this part, each of these themes and the related photographs will be presented.

1. Friction Force

One of the students was dramatizing friction force (the person on his knees) by making other student's walking difficult. Third student was pushing to dramatize applied force referring to the 25th, 26th, and 27th FCI questions (figure 1). Additional force was dramatized with one more student. These questions refer to different combinations of amount of applied force and friction force applied by the ground and questions how the motion would be.



Figure 1. Applications of some FCI questions related with friction force.

2. Hit and Motion

Generally, students experience difficulty to understand how instantaneous force will affect the direction of motion. In this role-play, female student represented hit (instantaneous force application) and its effect on disk's motion in the 8th, 9th, 10th, and 11th FCI questions (figure 2).



Figure 2. Applications of some FCI questions about hit and motion.

In rocket questions, including 21st, 22nd, 23rd, and 24th FCI questions, can be categorized in this category (figure 3). It should be noted that in these questions applied force is not instantaneous but continuous during motion. To dramatize the situation, one of the student walk along one dimension. And at a particular point another student began to push first student in perpendicular direction. Then, the motion can be analyzed with other students in the class.



Figure 3. Applications of some FCI questions related with rockets.

3. Velocity

By putting some piece of papers on the floor, they have been dramatized 19th and 20th FCI questions (figure 4). Students were counting together and walking step by step on the papers, so they dramatized the position in the questions.



Figure 4. Applications of some FCI questions about velocity.

4. Pushing" Action Reaction pairs"

By putting some piece of papers on the floor, they have been dramatized 19th and 20th FCI questions (figure 5). Students were counting together and walking step by step on the papers, so they dramatized the position in the questions.



Figure 5. Applications of some FCI questions related with action reaction pairs.

5. Falling Down

Gravitation force was represented with scarf and the students pulling the scarf. 1st, 12nd, 13rd and 18th FCI questions are dramatized with different applications (figure 6). When more than one mass is the case, number of scarves should be increased accordingly.



Figure 6. Applications of some FCI questions about falling down.

6. Circular Motion

The easiest decision was given in this drama application because 7th FCI question is about a man applying a circular motion on a ball (figure 7).



Figure 7. Drama application related with circular motion.

Other circular motion drama applications for 5th and 6th FCI questions are represented with all students (figure 8). They had formed a big circle and one student who symbolized the ball walked nearby his friends. They decided which way the ball will continue to move.



Figure 8. Some other drama applications about circular motion.

CONCLUSION

After completing such role-play activities, students claimed their enjoyment in the class while dealing with physics. This reaction highlights how dramatization besides visualization of the situations make easier solving FCI questions. From this point, it may be suggested that instead of asking questions directly, teachers may allow students to develop role-plays in an appropriate manner. Because such role-plays simplify the situations. By increasing the time spends on question, students would deeply engage with the physical and mental activation. Also, this environment facilitates collaboration in classroom where communication skills are activated. Every student in the classroom has opportunity to contribute understanding of the situation. On the other hand, FCI is mostly used for diagnostic purposes. As it can be put into one-tier diagnostic

test category, it is not possible to reach the reasons behind the answers. During role-play activities, teachers may find time to question students' understanding.

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