AC 2009-556: SYNERGISTIC LEARNING ENVIRONMENT USING BLACKBOARD LEARNING CELLS

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Synergistic learning environment using Blackboard learning cells

We report on an innovative approach to teaching Introductory Physics to general education students. Presentations can engage students meaningfully but employing the technique in large classes may be problematic. We tested the method on a class of sixty six students. Blackboard was used for student interaction; students were divided in six groups and Blackboard discussion groups were created accordingly. Questions pertaining to the covered topics and related to the students' majoring fields were formulated progressively in sets of six, weekly. Students from each group had to negotiate and be responsible for the question assigned to the group. A presentation session was introduced once a week. Although a relatively small weight of the presentation component was assigned, a positive atmosphere of support and collaboration was created. Students also practised their internet research skills by using audio and video resources available online. A synergistic effect was created due to the presentation component, which allowed all students to identify and reflect on physics ideas and their applications. The successful aspects together with possible improvements of the teaching procedures are reported.

1. Introduction

The use of Blackboard system [1] is widespread now and is recommended over regular course websites [2], as it is significantly more versatile for course management and interaction with students. The system is most effective for distance courses [3] as online courses [4] can be delivered in a consistent meaningful manner even if recent works show that there are some challenges associated with distance learning [5]. The system has great built in flexibility and allows instructors to use their imagination in designing the course [6], interacting with students, or documenting activity requirements [7]. In addition, it also facilitates the peer assessment process [8].

The Physics general education courses may sometimes present challenges due to the highly heterogeneous student population and to the level of interest in the course. Large classes also present challenges in engaging students during class time as well as in verifying the academic integrity of the submitted homework [9].

In the initial stages of the course, students often fail to see or acknowledge the relevance of the material to their field of studies. An initial in-class survey shows that student interest varies from 0 to 10 (10 being the maximum possible). Fig.1 shows the frequency of the answers with an average of 6.61 out of 10. There are various techniques developed by Physics instructors to engage students in the learning process. We have particularly designed the course to increase student interaction and allow them to make connections among the taught concepts and their relevance to personal interests. We innovatively made use of the available technology, particularly the Blackboard system. In any larger class it may often be difficult to make students active and to stimulate them to bring their own contributions to the course. The procedure we employed and on which we presently report used the Blackboard system in order to create virtual cells that can also interact. The taught class – Physics 100 level, four contact hours– comprised 66 students and we decided to partition the class into six cells of 11 students each. Large discussion groups on Blackboard are not effective [10]. We considered that the cells were small enough to allow for better student interaction, compared to employing the entire class. Using Blackboard, six discussion groups were created, one for each cell. A general discussion group for the entire class was also generated. A mandatory presentation component on an assigned topic was introduced in the syllabus. The weight of the presentation was reasonably low – 5% – so that students should not feel it as a big burden but also large enough to count towards the final grade if skipped. Students were informed that each cell would be assigned a particular presentation topic weekly. The students in the cell were responsible for delegating an individual to prepare and give a 5-7 minute presentation in front of the class; they were supposed to negotiate their turns to present the topics that were most relevant to their interests and to inform the instructor about their choice in advance. Six topics corresponding to each cell were uploaded on the Blackboard system regularly and presentations were always scheduled on the same day of the week. The assigned topics were to be further discussed with the instructor for a better understanding of the student's tasks. Student presentations, notes or internet links were to be uploaded and made available to the entire class; nevertheless, the choice was up to the student presenter. The presentation was evaluated by the instructor according to style, relevance to the assigned topic, and ability to answer related questions. There were no presentations for the first couple of weeks; then a series of 10 weeks followed when six students would each give a 5-minute presentation on the assigned topics.

The goal of teaching the course in this special manner was to engage students independently and collaboratively in exploring relevant engineering applications and the outside world, as they relate to the studied physics laws and principles.

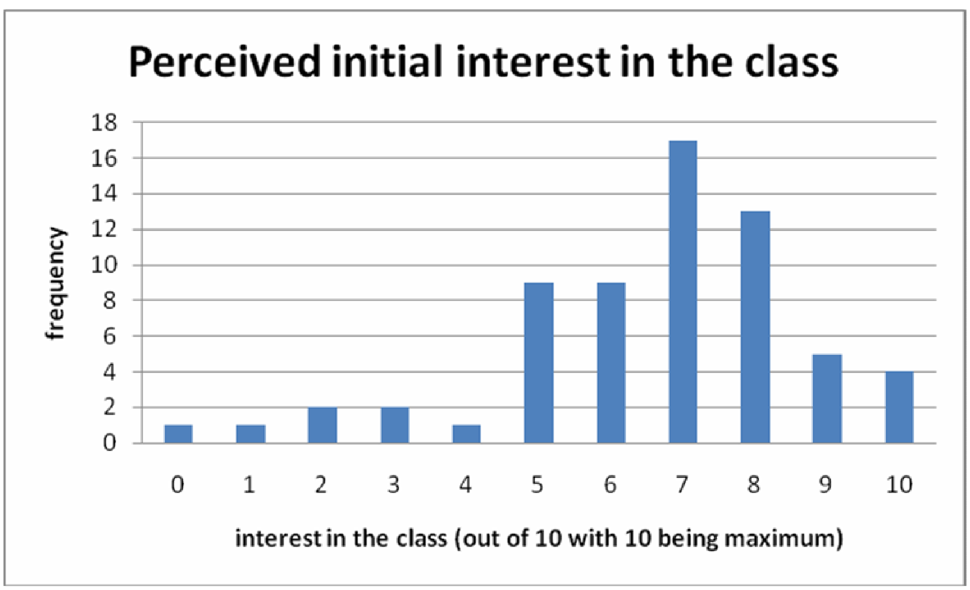

Fig. 1 Student interest in the physics class at the beginning of the course (64 out of 66 anwers)

2. Topics and guidelines

The topics were chosen to be either complementary to the material covered in the course or to reinforce some of the taught concepts. They were generated as we advanced through the material of the course so that only a few times the assigned topics were asynchronous with the material covered. For those particular cases, the instructor discussed the material with the student presenter in order to facilitate the understanding of the topic and of the worked needed. The list of the assigned topics is given below. The numbers (1 to 10) correspond to the ten weeks when students were giving presentations. The first few weeks allowed students to become familiar with the physics topics discussed and to gain a sense of what can and should be included in the presentations.

Specific guidelines were provided to students as follows:

There are 6 student groups (in alphabetical order) for PHY125. Please identify the group where you belong and get in touch with your group members using the group discussion board.

- One member from each group will present a short talk (about 5 min.) answering one of the proposed questions for the group. Each member of the group should volunteer to talk once during the semester.
- The group should support the presenter with ideas, internet links or materials. Each group should negotiate and decide who will be the presenter for the group's assigned topic.
- The presentations will normally be scheduled for Fridays, unless otherwise specified.
- By Tuesday of every week, the instructor needs to know the presenter for each group. The oral presentation will count towards the homework/quizzes grade.
- The presentation of the topic can be associated with electronic images, diagrams, or videos (this format is recommended). The speaker should present ideas clearly and attempt to generate class discussion related to the topic.

Additional oral details were further provided for the class and individually when requested.

Table 1 Assigned topics for presentations

Group1:
1. Find examples where inertia of objects can be dangerous. 2. What is the Physics/Mechanics of fireworks? 3. Find examples of situations in which the center of mass position plays an essential role. 4. Find examples to demonstrate the importance of centripetal/centrifugal force. 5. Identify physical principles (mechanical) used in the design of roller coasters and find examples to demonstrate them. 6. What is the Doppler effect (for mechanical waves)? Find real-life examples where the Doppler effect is used. 7. What are infrasounds? 8. Find examples employing Coulomb law. 9. Find examples employing the thermal effect of electric current. 10. What are Northern Lights? 11. Find some advantages and disadvantages associated with the usage of AC and DC.
Group2:
1. Give practical examples of situations when the vector nature of a quantity plays an essential role. 2. Find real life examples of stable and unstable mechanical equilibrium. 3. Find examples of systems with stored potential energy that may be dangerous if the potential energy is accidentally released. 4. Find interesting examples of real life elastic and inelastic collisions. 5. Find why and how roller coasters can be dangerous. 6. What are standing waves? Find real-life examples. 7. a) Ultrasounds used by animals and insects. Find real-life examples. b) Find and discuss real-life examples of electrostatic discharges. 8. Infrasounds: what are their applications and physiological effects?

9. What is an ultra-capacitor and what are some of its applications?
10. Discuss the principle of electromagnetic induction and find relevant practical applications?
11. Find some advantages and disadvantages associated with the usage of AC and DC.

Group3:

1. How is Physics similar and different from Chemistry, Biology, or Mathematics?
2. Explain and find examples: weight, apparent weight, weightlessness.
3. Find interesting examples of systems/ situations that employ the conservation of mechanical energy.
4. Find real life examples in which the vector nature of the conservation of momentum is evident.
5. Find examples to demonstrate the importance of centripetal/centrifugal force.
6. Find situations where the energy transport of waves is threatening or detrimental to human beings or life.
7. Principles and applications of ultrasounds.
8. Identify locations where lightning is more likely to strike.
9. Find living organisms sensing the magnetic field.
10. Discuss the role of electromagnetic induction in the production of electrical energy.
11. Find examples and discuss possible explosions of power transformers.

Group4:

1. Find situations where accelerated motion can be hazardous to humans. How much acceleration can the humans withstand?
2. Demonstrate the principles of physics involved in rock climbing.
3. Based on the conservation of mechanical energy, explain how the speed of a satellite launched on an elliptical trajectory around the Earth changes. Try to extrapolate conclusions to the elliptical trajectories of planets around the Sun.
4. Identify relevant laws and mechanical phenomena involved in the billiards game.
5. Show how the weight of a person can be different at different locations on earth.
6. What are forced oscillations and "resonance"? Find real-life examples of resonant energy absorption with threatening or catastrophic consequences.
7. Find real-life examples of longitudinal, transversal or other types of waves.
8. Find and discuss real-life examples of electrostatic discharges.
9. Find applications using magnetic fields.
10. Discuss the importance of transformers in daily life.
11. Identify electromagnetic induction applications in your house.

Group5:

1. Action and reaction: applications and precautions.
2. Find examples where the switch from static friction regime to kinetic friction can have significant or hazardous consequences.
3. Find relevant examples of situations in which the conservation of energy appears not to be valid and try to explain how this happens.
4. Find situations where torque is relevant to real life situations.
5. Zero gravity: how can weightlessness be experienced and what are the principles behind it?
6. What are the physical principles inducing the pendulum motion? Find examples where the pendulum motion is connected with the Earth's rotational motion.
7. Find real-life examples of charged objects around us and discuss their consequences.
8. Discuss the physiological effect of electric current in biological tissues.
9. Characterize the Earth's magnetic field and find some implications to life on Earth.
10. Discuss the role of electromagnetic induction in the production of electrical energy.
11. Find issues related to electronic devices produced in North America when they are to be used in Europe.

Group6:

1. Friction forces: applications and precautions.
2. Find real-life examples of useful and dangerous manifestation of inertia.
3. Find relevant examples to stress the differences between power and energy.
4. Find situations to demonstrate some peculiarities of rotational motion.
5. How is the weight of a person different on other planets/moons? Find suggestive examples.
6. What are the physiological effects of high intensity sound on humans? Find standards and protective means against high intensity sound threat.
7. Find examples employing Coulomb law.
8. Find examples of hazards due to exposure to electric field or current.
9. Find examples showing the correlation between the Sun's magnetic activity and life on Earth.
10. Discuss transmission of energy from the producer to the consumer.

3. Implementation and Results

Students used simulations, videos, and photos; shared their own experience and what they learned from others; employed their imagination; compiled and presented the material in a manner often appealing to their peers. They brought to class many experiments we could not otherwise reproduce in class. Not all the presentations were up to standards, but there was always some effort involved as the presentation was done in front of a reasonable large class. The instructor usually received the presentation file the day before the scheduled presentation.

Few of the students were initially concerned about giving a talk in front of the class. However, as they witnessed their peers' performance, it became routine. There were only two cases when for unknown reasons the presentation was skipped.

Fig. 2 Sample screenshots from student presentations

Often interesting Youtube videos relevant to the presenter's topic were identified and shared with the class. Here are some sample links provided by students:

pool: http://www.youtube.com/watch?v=pZqkaJDaz2A
zero gravity http://gozerog.com/index.htm
resonance: bridge collapse http://www.youtube.com/watch?v=P0Fi1VcbpAI
Doppler effect: http://www.youtube.com/watch?v=imoxDcn2Sgo

standing waves: http://www.youtube.com/watch?v=MPcJbb5Qfj0
http://www.youtube.com/watch?v=EOdTMm_QxTw
simple pendulum simulation: http://www.myphysicslab.com/pendulum1.html
Foucault pendulum: http://www.physclips.unsw.edu.au/jw/foucault_pendulum.html
sound perception: http://www.youtube.com/watch?v=oefVaHDo5xg
close-up of a lightning strike: http://www.youtube.com/watch?v=Sn65RFvJKnk
Japanese Maglev train: http://www.youtube.com/watch?v=VuSrLvCVoVk
Aurora Borealis: http://www.youtube.com/watch?v=XO8LSFA9X1Y
electrical explosions and arching: http://www.youtube.com/watch?v=SF5HuO-2Ci0&NR=1

4. Benefits of organizing the course in Blackboard learning cells

In the instructor's opinion there were significant benefits in teaching the course in the fashion discussed above. The presentation sessions uniquely allowed for direct interaction; appreciation of the students' interests, of their ability to relate concepts to engineering applications and to real world phenomena, of their skills in researching new material and presenting it in front of the class. Here are some remarks we believe are pertinent to class performance:

- Students learned to appreciate the research and presentation efforts made by themselves and their colleagues. To some extent their appreciation of the presenter (clapping and encouragements) was influenced by the quality of the presentation.
- Students gained confidence in their ability to perform this specific task (some of them were rather skeptical about performing in front of the class) and they also derived a sense of accomplishment. Particularly, we witnessed great support for a student with disability, who could have skipped this requirement but chose to go with it. A colleague encouraged him consistently and she and the rest of the class were all proud of his performance.
- The presentations revealed the students' interests, taste and personality in selecting the presentation material and sharing it with the class.
- Students interacted more than they would otherwise, as they had a new task in common as well as experience to share in performing it.
- Some students who were otherwise unremarkable in the class demonstrated great interest and selectivity in physics related applications, which greatly pleased the class and the instructor;
- Individual contributions were possible from each and every student in a sizable class
- Students know to use the web and like to do it; this was a special chance to employ those skills for their own and for the class's benefit;
- Additional topics and engineering applications could be explored by the whole class (66 students) and the material was available to everyone; this offered an alternative to having the instructor alone identify the appropriate applications and visual materials (images, videos, websites).
- Direct and electronic collaboration and communication were developed among students;
- Students were offered a small bonus for excellent performance in the presentations but no penalty for poor performance;

- Presentations helped students tune in to their own preferences in terms of material selected and the way to present it; they were pleased to share their brief research with their colleagues
- Presentations included photos and videos from around the globe, thus acquiring to a certain extent a social and cultural role.

5. Room for improvements

Electronic interaction was only partially successful as the discussion groups were more active at the beginning of the course. It is possible that even smaller groups of 4-6 students as suggested by [10] may engage students in more discussion board interactions.

There were two students who did not present a topic; they did not provide a reason, nor did they ask for a waiver. Additional opportunities for presenting a topic were offered at the end of the course but they were not considered. It would be beneficial in the future to identify the reasons for skipped presentations and take steps to alleviate the associated issues.

Sometimes presentations were not finished a day ahead of their due time and the instructor had to accept and assess the work on the spot. No specific penalty was introduced as long as the presentation was performed in a decent manner. It may be helpful to introduce some small penalties for presentations not finished by the deadline.

We believe that maybe spreading the presentations throughout the week rather than scheduling them all on the same day of the week could be more beneficial to the students and may engage them more into the learning and sharing process.

6. Conclusions

It is particularly challenging for the instructor to teach a course when student interest in the course is low. An important reason for lack of motivation in the course is the students' failure to see how the material applies to their major. The present organization of the course included Blackboard learning cells meant to increase student interaction due to the necessity of negotiating the presentation topics proposed. The presentation component of the course was initially perceived as somehow challenging. However, as we progressed in the course, it became an interesting and rewarding activity both for the presenter and the class. Virtually every student chose a particular topic he/she favored over any other ones offered. Each student performed some research in order to identify applications of physics principles discussed in the course and shared his/her findings with the class in a personal style. The Blackboard learning cells made students feel that they belonged to a smaller group in which they could easily interact. The applied method did support collaboration among students, although not to the extent initially intended. It may be possible that smaller student cells would generate more Blackboard discussions and collaborations than were presently noticed. However, the benefits of the reported experiment greatly outweighed the challenges introduced by the method. We are hopeful that or experience may be beneficial to others in the field, although small innovations and adjustments to the general characteristics of the class are always needed.

7. References

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