Disco Dancing and Kinetic Theory

Article *in* Journal of chemical education · July 2010

DOI: 10.1021/ed100226r

Mehmet Karakas

Artvin Coruh Universitesi

Disco Dancing and Kinetic Theory

Mehmet Karakas
School of Education, Artvin Coruh University, Artvin, Turkey
mkarakas73@yahoo.com

Many science educators see teachers' professional development as the most critical and complex variable in the science education reform movement *(1, 2)* (ref *3*, as cited in ref *4*). The National Research Council (NRC) standards *(5)* state, "since the current reform effort requires a substantial change in how science is taught, an equally substantive change is needed in professional development practices" (p 56 in ref *5*). The goal of teacher education programs should not be to indoctrinate or train teachers to behave in prescribed ways, but to educate teachers to reason soundly and scientifically about their teaching as well as to perform skillfully (ref *6*, as cited in ref *7*). Better prepared teachers, in both pedagogical content knowledge and their science knowledge, are strikingly more effective in developing higher-order thinking skills and meeting the needs of diverse students through different learning approaches (refs 8, 9, as cited in ref *7*). Science educators recommend conceptual teaching of problem solving and thinking skills, life relevancy, and life experiences (ref *10*, as cited in ref *7*). Problem solving and thinking skills that revolve around life experience may be better taught through student-centered classrooms that emphasize process-oriented learning *(11)*. On the other hand, in constructivist learning theory, knowledge is constructed individually by every learner. Students do not accumulate all the knowledge that is presented to them as it is. In this model of learning, individuals' prior knowledge, individual capabilities, and learning environments are very important *(12)*. New knowledge has to be connected with an individual's prior knowledge so that it can have some meaning to the individual. Thus, students' prior knowledge plays a great role in accumulating and putting in context the new knowledge that they are learning *(13)*.

This paper is the result of an innovative introductory science activity planned, designed, and implemented by the instructor in a science methods class for elementary teachers (preservice teachers) in Turkey that aimed to achieve the above-mentioned science teacher education goals. The main objective was to use a simple yet novel (and engaging) approach to foster understanding among prospective elementary teachers of kinetic-molecular theory. As Wiggins and McTighe wrote, "Teaching for understanding has to be every teacher's purpose in teaching" *(14)*. Scientific conclusions have to be artfully interpreted by teachers and applied to particular educational situations, even if we grant that there is something to apply (ref *15*, as cited in ref *7*). Based on this philosophical stance, the instructor incorporated a disco bar (nightclub) analogy to make a science concept easier for preservice teachers to understand and construct meaningful new knowledge. Moreover, this analogy could help preservice teachers understand what the term "teaching for understanding" means by seeing the example of teaching for understanding implemented by their instructor. The kind of analogy used here is already reported in the literature *(16, 17)*, and the analogy described in the present work was built on these previous works. A number of researchers have noted that analogies can be seen as a "two-edged sword" in that they help students to understand difficult scientific concepts, however, if not used properly, analogies can engender alternative conceptions *(18)*. The instructor was aware of this possibility.

Connecting to the Real World

The best intellectual learning occurs in a context that illustrates its practical value (ref *19*, as cited in ref *7*). Brodhagen, Weilbacher, and Beane*(20)* proposed that if the curriculum is to support a genuine search for self-and social meaning, then it ought to be drawn from concerns young people have about themselves and their world. Bearing this in mind, the instructor modified the instructional material of a science lesson on kinetic theory to connect students' learning to the world around them by teaching the concept of kinetic theory in a way that connects with their social environment and daily life. As Art Hobson claims *(21)*,

> [I]ntroduce scientific terms only when they are useful in describing or understanding a significant concept. Introduce the concept first, convince students that it is useful, and only then give it a name. It is the idea, not the name that is important.

The instructor followed this methodology.

Explaining the Lecture

To begin, the instructor changed the title of the lesson from Kinetic Theory to Dancing in a Disco Bar, to attract students' attention. When the title was presented to the class, there was complete silence and rapt attention as the students were curious to know why the instructor was talking about dancing in a disco bar in a science class. All the 62 students in the science methods class were junior students in the sixth semester of their study of elementary teaching in a small university in northeast Turkey.

These preservice teachers had taken few science courses in high school, and thus were unfamiliar with kinetic theory. In Turkey, high school students have to choose their track of study in their first year (grade IX) from among mathematics, science, and social sciences. The students who choose social science studies have very few science classes throughout their high school. There is a nationwide university entrance exam in Turkey, and students who graduated from social science studies can only choose certain majors in university, one of which is the elementary teaching program. When asked whether they have ever heard the term "kinetic theory", some students said that they had heard about it in the news, but they did not know what it was about; some said no. The instructor noted to the class that the students knew about kinetic theory, without realizing that they knew it, and that they would see they know kinetic theory already.

The lesson began by inquiring whether the students had ever been in a disco or at house parties where loud music was played.

10.1021/ed100226r Published on Web 07/08/2010

Most of these students had been to house parties, and some had been dancing in a disco. The instructor suggested recreating a disco atmosphere in the classroom and asked for a student volunteer to be a disk jockey (DJ). Several students volunteered, and one was selected as a DJ. This student was handed the laptop brought to class by the instructor and asked to play some music already in the laptop. The laptop was then attached to loud speakers, and while the student DJ played some club music with fast beats, the instructor asked other students in the class to come to the front of the classroom and dance as they liked. Several students danced enthusiastically to the fast-beat music in a confined area in front of the classroom. (In this exercise, dancers are equivalent to molecules, and the music beat is equivalent to temperature in kinetic-molecular theory.)

The instructor then asked the student DJ to switch to music with a slow beat, such as ballads and soul music. (The music that was played was popular music heard on radio stations at that time in Turkey.) Finally, the instructor had the student DJ stop the music and asked students what they just observed. Several students said that they felt like they were in a party. Then the instructor asked what happened when the student DJ switched the beat of the music from fast to slow. One student said that those who were dancing with fast movements slowed their movements with the change of the music beat. The instructor then asked whether any of them had had that experience, to which most of the students said yes.

An explanation of kinetic theory ensued, connecting what most of the students had already experienced of how kinetic theory works, because nearly all of them had had dancing experiences and had danced to music with fast and slow beats. The instructor then explained that kinetic theory worked in the same way. When molecules are heated in a fixed-size, closed space, they start moving faster, as did the students who were initially dancing faster with the fast-beat music, and that is why the molecules will try to expand to have more space around them. However, in a fixed-size, closed space that is not capable of expansion, molecules will increasingly collide just as dancers on a crowded dance floor will start bumping into other dancers while dancing to fast music. Conversely, when molecules are cooled in a fixed-size, closed space, they start moving slower, as did the students who danced slower to the slow beat music. This is why dancers are less likely to bump someone while dancing to slower music, because the size of the space they occupy remains fixed. Later, the instructor familiarized the preservice teachers with kinetic theory as it was described in the textbook. Thus, there was a gradual shift from known to unknown as recommended by Lawson *(22)*. By using an alternate explanation with simple terms to begin with (language and experience known to the students) these students will be able to more fully understand and build on the meaning of the concept taught.

Conclusions

The instructor described the mechanisms underlying kinetic theory by arousing the curiosity of the students (the attractive title), by sustaining their interest throughout the topic (relating it to real-life activity), and by using simple language appropriate to their level of understanding *(7)*. This way of explaining kinetic theory could also be used in science teacher education, high school science classes, and maybe even middle schools, however it is definitely appropriate for introductory science courses, because it is really related to undergraduate students' life experiences at the moment they are in college. Many science educators recommend connecting difficult science concepts to real-life experiences. In this article the instructor tried to implement an innovative science lesson by connecting kinetic theory to real-life experiences (dancing at a disco). Teaching in ways described in this article supports the National Research Council's call for "substantial change in how science is taught" and also contributes to science teachers' professional development practices (p 56 in ref 5). Teaching in ways described in this article could help science educators educate future science teachers to reason soundly about their teaching as well as to perform skillfully *(6)*. It also supports Rutherford and Ahlgren's *(10)* call for conceptual teaching for life relevancy and life experiences, and Cachapuz and Paixao's *(11)* call for student-centered classrooms that emphasize process-oriented learning and thinking skills that revolve around life experience, and presents preservice teachers with teaching strategies that challenge their thinking and encourage them to ask questions. Teaching in ways described here gives an example of the Holmes Group's *(23)* call for vigorous modeling of student-centered and process-oriented instruction in which teachers actually learn science content. Furthermore, I think every teacher should implement the activity presented in this paper in his or her own way. One related example for connecting students' real-life experiences to the concepts embedded in kinetic theory compares students' behavior in the school library (where they must be quiet and probably move more slowly) to their behavior in the school student center (where there is more noise, and students can move around more quickly). Another example could be students at a sporting event, where it is often very loud, and people are moving around frantically at times while cheering, while at other times the crowd is hushed and still.

Literature Cited

1. Moore, R. National Goals and the Training of Teachers. *Am. Biol. Teach.* **1997**, *59* (4), 166–174.
2. Wheeler, G. The Wake-Up Call We Dare Not To Ignore. *Science* **1998**, *279*, 1611.
3. Moreno, N. P. K−12 Science Education Reform: A Primer for Scientists. *BioScience* **1999**, *49*, 569–576.
4. Karakas, M. Graduating Reflective Science Teachers through Problem-Based Learning Instruction. *Bulgarian J. Sci. Educ. Policy* **2008**, *2* (1), 59–71.
5. National Research Council. *National Science Educational Standards*; National Academy Press: Washington, DC, 1996.
6. Fenstermacher, G. D.; Soltis, J. F. *Approaches to Teaching*; Teachers College Press: New York, 1986.
7. Karakas, M. Two Equations of Life. *Sci. Educ. Rev.* **2008**, *7* (1), 9–11.
8. Druva, C. A.; Anderson, R. D. Science Teacher Characteristics by Teacher Behavior and by Student Outcome: A Meta-Analysis of Research. *J. Res. Sci. Teach.* **1983**, *20*, 467–479.
9. Begle, E. G. Critical Variables in Mathematics Education: Findings from a Survey of the Empirical Literature; Mathematical Association of America: Washington, DC, 1979.
10. Rutherford, F. J.; Ahlgren, A. *Science for All Americans*; Oxford University Press: New York, 1990.
11. Cachapuz, A.; Paixao, F. Placing the History and the Philosophy of Science on Teacher Education. In *Rethinking Science and Technology Education To Meet the Demands for Future Generations in a*

Changing World; Bizzo, N., Kawasaky, C. S., Ferracioli, L., Rosa, V. L., Eds.; IOSTE: Parana, 2002; pp 10−19 of the Xth Symposium Proceeding, Vol. 1.
12. Driver, R.; Bell, B. Students' Thinking and the Learning of Science: A Constructivist View. *School Sci. Rev.* **1986**, *67* (240), 443–456.
13. Naylor, S.; Keogh, B. Constructivism in Classroom: Theory into Practice. *J. Sci. Teach. Educ.* **1999**, *10* (2), 93–106.
14. Wiggins, G. P.; McTighe, J. *Understanding by Design*; Association for Supervision and Curriculum Development: Alexandria, VA, 1998.
15. Dewey, J. *Experience in Education*; Macmillan: New York, 1963.
16. Pendlington, S.; Palacio, D.; Summers, M. Understanding Materials and Why They Change. In Pack 4 of the Series, *Understanding Science Concepts: Teacher Education Materials for Primary School Science*; University of Oxford: Oxford, U.K., 1993.
17. Harrison, A. G.; Coll, R. K. *Using Analogies in Middle and Secondary Science Classrooms: The FAR Guide, an Interesting Way To Teach with Analogies*; Sage: Thousand Oaks, CA, 2008.
18. Harrison, A. G.; Treagust, D. F. Teaching with Analogies: A Case Study in Grade 10 Optics. *J. Res. Sci. Teach.* **1993**, *30*, 1291–1307.
19. Shaker, P. Literacies for Life. *J. Educ. Leadership* **2001**, *59* (2), 26–29.
20. Brodhagen, B.; Weilbacher, G.; Beane, J. A. What We've Learned from "Living in the Future. In *The Curriculum: Problems, Politics, and Possibilities*; Beyer, L., Apple, M., Eds.; State University of New York Press: Albany, NY, 1998; pp 117−133.
21. Hobson, A. Teaching Relevant Science for Scientific Literacy. *J. Coll. Sci. Teach.* **2000**, *30* (4), 238–244.
22. Lawson, A. E. What Should Students Learn about the Nature of Science and How Should We Teach It? *J. Coll. Sci. Teach.* **1999**, *28* (6), 401–411.
23. *Tomorrow's Teachers: A Report of the Holmes Group*; The Holmes Group: East Lansing, MI, 1986.