Newspaper Physics for First-Year College Students
An Interdisciplinary Approach
By E. J. Bahng, John Hauptman, and Jennifer Lowery

This article describes and illustrates a physics course for first-year college students whose only knowledge of physics is that they do not like the subject. The physics content is driven entirely by what appears in the daily newspapers and generally covers most physics topics in a semester. This course was structured as a learning community that combined English and physics in a single 6-credit course. Most of the writing assignments were about physics. A semester-long overview is shared, as is the instructional model for Newspaper Physics. We also provide three examples of how this model is used. Findings indicate that students gained higher physics content knowledge, higher-order thinking skills, greater confidence in seeking help and understanding science, and more opportunities to work with peers outside of class. This study contributes community-based interdisciplinary teaching and learning strategies.

Teaching physics directly from newspapers seems challenging, particularly with the near dominance of bite-size media clips. Yet it is still probable that good, high-quality primary news comes from traditional newspapers. We describe an experimental learning community course combining physics and English for first-year college students whose cognitive and social integration are deemed to be important factors for their persistence and success (Tinto, 1997).

Interdisciplinary methods of learning
Newspaper Physics, a learning community course, is based on interdisciplinary methods of learning that bring multiple concepts at once to an open discussion. The goal is to center the complexity, inseparability, harmony, and uncertainty between nature, society, individuals, and culture (Repko et al., 2009). Therefore, interdisciplinary learning results in students’ engagement and the synthesis of varied perspectives for a comprehensive and coherent understanding of topics of interest.

Unlike single-discipline or interdisciplinary science learning, interdisciplinary learning in general involves much broader, nonscience disciplinary areas (Jain, 2019). Due to this greater interconnectedness among relatively expansive fields, some argue that interdisciplinary learning fosters meaningful engagement as well as critical-thinking and problem-solving skills that resemble real-world ad hoc contexts and decision-making (Archer, 2007; Repko et al., 2009). Consequently, this learning approach not only allows great content flexibility for the instructors by providing “cognitive toolkits” but also gives students sustained and meaningful “relational domains and spaces” where they can engage in often-conflicting viewpoints and complex social questions in flexible, collaborative, and safe learning environments (Jain, 2019; Repko et al., 2009).

Shifting from stereotypical views of physics to balanced views of physics
Physicists and the field of physics are consistently negatively portrayed in that physics is perceived to be a highly tech-oriented and mathematical formula–driven unattractive field, a field only for a lonely, highly intelligent male physicist, and, furthermore, a field that limits female scientists’ contributions (Bahng et al., 2020; Bang et al., 2014; Hazari et al., 2020; Mead & Metraux, 1957). First-year college students who take this interdisciplinary learning community course may be surprised to see that elementary, easily understood physics is often found in everyday phenomena and intimately embedded in our social environment.

First-year college students in Newspaper Physics are encouraged to explore the interplay of science and society and, as a result, improve their perceptions of science and broaden
their interests and sense of belonging, thus developing a conceptual and social relationship with core physics ideas and with the learning community, respectively. Similarly, the physics community often involves collaboration between multiple groups of scientists from around the world who work together in various specialized areas toward shared and targeted goals (e.g., physics, technology, theoretical concepts, development of sophisticated high precision instruments; American Association for the Advancement of Science, 1989).

Furthermore, first-year college students who are science majors comprehend and appreciate the foundational physics content in its simple-yet-complex forms and discover that mathematics is not always necessary to understand physics. For students with varied backgrounds and competence levels, crosscutting ideas and direct relevance to current events are intrinsically educational and inclusive. For instance, among nonscience students, the “fear of physics” can be shifted to an appreciation of the role that simple physics plays in our everyday lives and culture (Krauss, 1993; Lipszyc, 2012).

For female students, who have historically been identified as an underrepresented group, this interdisciplinary physics course can be an optimal learning environment to start shaping themselves as “physics people.” According to Hazari et al. (2020), four factors contribute to orienting a person toward the world of science, as well as to aligning knowledge, skill and role sets, and habits of minds with a subject-specific science field. Hazari et al. synthesized, conceptualized, and explained these concepts as follows: (i) performance and competence beliefs (belief in one’s ability to perform and understand physics); (ii) recognition (perception of how others view themselves in relation to physics); (iii) interest (desire or curiosity to think about and understand physics); and (iv) sense of belonging (perception of fitting in or not feeling excluded from the community). Hazari et al. argue that these four factors can power the engines that form physics identity—that is, shifting one’s identity from student to aspiring physicist and, finally, to physicist (Irving & Sayre, 2013). The successful inclusion of a historically marginalized group of students as well as the promotion of balanced views of physics can lead to increased numbers of college students from diverse backgrounds pursuing their careers in science, technology, engineering, and mathematics (STEM) fields and the STEM-related workforce that is in critical need (American Association for the Advancement of Science, 1989).

It seems, however, that science education, and physics education in particular, is neither obvious nor linear from elementary school to the university level. Both the number of students who seek to major in physics and the number of those students who persist to earn a bachelor’s degree are small (Chen, 2013). Many students have no interest in science of any kind and, indeed, may be hostile to the thought of physics, partially due to a physics education that seems to be entrenched in androcentric and calculation-obsessed learning without relevance (Bahng et al., 2020; Johansson et al., 2018). We hope to mitigate the underlying mechanisms of hostility to science, generate a physics-narrative teaching model to change these negative perceptions, and foster students’ critical thinking in a way that respects varied ways of being and of learning physics.

The desired outcomes from a course like this one are to establish a new platform on which to teach physics, develop effective oral and written scientific communication skills (Leshner, 2012), and motivate first-year college students to appreciate and humanize science. In particular, students are exposed to the aesthetic experience of physics, integrated with many other disciplinary areas and taught without mathematics, thus breaking a stubborn misconception about physics (i.e., that one has to master mathematics to learn physics).

The learning community: Newspaper Physics course structure

A learning community course, Newspaper Physics was developed by interweaving English writing and oral assignments with physics concepts and problems as basic constructs. English content included writing rhetorical, argumentative, biographical, opinion, and other types of pieces that were mainly centered around the physics discussions. The students kept a physics journal, wrote reflection pieces on the content of newspaper articles, interviewed physicists on campus and at Fermilab, and had regular book club meetings. As a final project, they analyzed newspaper articles of their choice and presented similar physics discussions on these.

This course was taught over 13 years, and a recent honors course was taught with engineering students with the physics component but not the English component. Due to the popularity of the course and the course’s effectiveness for learning and teaching, its instructors received outstanding innovative teaching awards during their second year of teaching based on criteria that included student and peer evaluations, assessments of classroom teaching performance, and evidence of instructional contributions outside the classroom. We outline core elements for the course in Table 1.

Students taking the course earned 3 credits for English and 3 credits for physics, satisfying both the language
TABLE 1
Newspaper Physics core elements.

<table>
<thead>
<tr>
<th>Elements</th>
<th>Brief descriptions</th>
</tr>
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<tbody>
<tr>
<td>Course name</td>
<td>Newspaper Physics</td>
</tr>
<tr>
<td>Credits</td>
<td>A total of 6 credit hours (3 credit hours for English 250 and 3 credit hours for Physics 290)</td>
</tr>
<tr>
<td>Instructors</td>
<td>An instructor from the English department and an instructor from the physics department</td>
</tr>
<tr>
<td>Class meeting days</td>
<td>English 250 meets on Monday, Wednesday, and Friday. Physics 290 meets on Tuesday and Thursday.</td>
</tr>
</tbody>
</table>
| Required texts                 | • *They Say/I Say With Readings* (2nd ed.), by Gerald Graff, Cathy Birkenstein, and Russel Durst  
                                 | • *The Artist's Way*, by Julia Cameron  
                                 | • *A Pocket Style Manual* (6th ed.), by Diana Hacker and Nancy Sommers  
                                 | • ISU Student Guide English 150 and 250 (a departmental packet on basic English writing skills expected of all university students)  
                                 | • *Six Easy Pieces*, by Richard Feynman                                                                 |
| Book club books                | • *The Hunger Games*, by Suzanne Collins  
                                 | • *Ender’s Game*, by Orson Scott Card  
                                 | • *Good Omens*, by Neil Gaiman and Terry Pratchett  
                                 | • *Feynman*, by Jim Ottaviani and Leland Myrick (graphic novel)                                                                 |
| Participation requirements     | • Come to class prepared and participate.  
                                 | • Do the assigned readings.  
                                 | • Complete all major assignments.                                                                                                                                 |
| Course objectives              | • The objective of Newspaper Physics is to teach physics and argumentation. Newspaper Physics is specifically designed to help you learn how to think and write about physics and how to analyze and construct argumentative writing. |
| Course outcomes                | The academic goals were to  
                                 | • summarize and rhetorically analyze written and visual texts;  
                                 | • target an audience according to the writing purpose and situation;  
                                 | • practice effective writing processes (planning, drafting, revising);  
                                 | • learn enough about physics to be able to discuss, question, and write about it;  
                                 | • conduct effective scientific interviews of physicists;  
                                 | • document sources using in-text citations;  
                                 | • present scientific material orally and visually and answer questions;  
                                 | • apply the principles of design to craft effective documents;  
                                 | • independently evaluate your writing concerning content and form to produce effective and error-free writing; and  
                                 | • understand and incorporate ethical practices in your writing.                                                                                                                                 |
| Major in-class, out-of-class, and off-campus activities | • A biographical piece called “Thinking About My Major”  
                                 | • Introduction to journals and book club  
                                 | • Interview of an ISU physicist, written up as a newspaper article (can be sent to local or student newspaper)  
                                 | • Op-ed and cover letter (can be sent to a local or state newspaper)  
                                 | • Interview of Fermilab physicist, on an overnight trip to Fermilab (Batavia, IL)  
                                 | • *Artist’s Way* journal and book club (meets once per week)  
                                 | • Physics journal (writings in a private journal on the physics presentations)  
                                 | • Portfolio (demonstrating physics savvy, participation, and group spirit)                                                                 |
| Community dinner               | • Cook dinner together (e.g., salad, pasta)                                                                                                       |
and natural sciences requirements in the College of Liberal Arts and Sciences; thus, the course was effectively a 6-credit course with one letter grade. The class consisted of about 20 mostly first-year students, about equally divided between male and female students. At the midsemester point, the whole class took a 2-day trip to Fermilab, the main high-energy physics international laboratory in the United States, where they individually interviewed physicists, engineers, and graduate students from around the world and then wrote newspaper articles based on these interviews.

A typical weekly schedule consisted of 50-minute English class meetings on Mondays and Wednesdays, plus a “writer’s workshop” format of four students and one instructor on a separate day, when each student read their work, offered criticism, and rewrote. The physics narratives were 80-minute meetings on Tuesdays and Thursdays. The final week of the course included students giving presentations, having a community dinner, and turning in their portfolios.

There were no exams or any traditional assessment strategies used in this course. Instead, performance assessments such as a portfolio, oral presentation, interviews, and written assignments were incorporated. Writing assignments were given once per week on a wide range of topics, and instructors provided verbal and written feedback. In addition, students engaged in self-criticism in small writing groups of four students, in a format similar to professional writers’ workshops. In the end, students were evaluated based on the whole portfolio they had produced during the semester. The community of students created a collage or class book in the end.

### Physics community shared book and newspaper articles

A required physics book for the learning community was Richard Feynman’s *Six Easy Pieces*, which includes six chapters from his physics course at the California Institute of Technology, containing few equations and showing that all subjects in physics can be talked about in a conversation. We will briefly illustrate the style and content with the following examples, followed by short notes on several other articles.

### How to find physics articles in the newspaper

The physics instructor, having developed a great love of newspapers from the *San Francisco Chronicle* and the *Los Angeles Times*, would read local, regional, and national newspapers from the level of skimming to detailed reading, putting aside articles containing any degree of physics, such as a multiple-exposure image of an Olympic ice skater doing a triple lutz as a near-perfect illustration of angular momentum conservation or a story about Prince Charles’s lyrist playing her lyre at a New York exhibition (standing waves on the strings of a lyre). Overall, the *New York Times* (*NYT*) supplied about half of the articles used in this course. Figure 1 illustrates a screenshot of some collected newspaper articles listed in a spreadsheet.

There are articles about physics, often in the Science Tuesday section of the *NYT*. There are articles about physicists in obituaries (again in the *NYT*, which is now printing obituaries often of women and people of color and referring to them as “overlooked no more”). In the Arts and Music section, a photo of a lyre or piano is enough to talk about standing waves on strings under tension with differing mass densities and lengths. On the topic of forensics, there are art forgeries uncovered by radiological measurements and electron beam or neutron imaging.

### Figure 1

**Screenshot of a list of the collected newspaper articles (52 articles out of approximately 550).**

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Date</th>
<th>Page</th>
<th>Page 1</th>
<th>Page 2</th>
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</thead>
<tbody>
<tr>
<td>[List of articles]</td>
<td>[Author List]</td>
<td>[Date List]</td>
<td>[Page List]</td>
<td>[Page 1 List]</td>
<td>[Page 2 List]</td>
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activation analysis (the Louvre has an accelerator in its basement). There are archeological sites found with ground-penetrating radar, Lidar, or magnetic probes, as well as satellite imaging of ancient trade routes, along which the ground is depressed about a foot by the hooves of camels.

Furthermore, there is public policy discussion of nuclear weapons and proliferation, space weapons, and the use of tasers by police and resulting deaths. There is human folly (e.g., the guy who thought he could drive his pickup truck home without brakes by dragging his foot on the road). Finally, there are random events and statistics, such as birth announcements (male-female fluctuations are binomial), death announcements (mean female age at death is 7 years older than the age of males), and annual statistics on fatal road accidents. (The variations year-to-year are Poisson, and one expects fluctuations of the square root of N.)

There are topics that recur—sometimes annually, such as end-of-year articles about road fatalities in Iowa (Poisson statistics)—or periodically, such as asteroids crossing Earth’s orbit (end of dinosaurs, mass extinctions, probability and statistics). Some stories have follow-ups, like the Polonium-210 poisoning and death of Alexandre Litvinenko, a critic of Russian president Vladimir Putin, which was followed years later by his wife suing the Russian Federation (Stringer, 2006).

**Newspaper Physics instructional model**

Figure 2 illustrates the instructional model for Newspaper Physics. This course depends on the availability of current news, primarily in the daily local and national newspapers, including news stories posted online. An essential need for this course is an instructor who is broadly aware of current events from a broad range of news sources. In addition, students in the class are encouraged to suggest articles.

In the interests of space, we selected three newspaper articles for this article: (i) “Teen Thrown in Air Holds on to Wires” (*Iowa State Daily*, January 29, 2003); (ii) “Thousands Die as Quake-Spawned Waves Crash Onto Coastlines Across South Asia”; and (iii) “7 Go on Trial Over Quake”.

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**FIGURE 2**

**Newspaper Physics instructional model.**

**TABLE 2**

Three vignettes, extracted stories, physics concepts, and concept applications.

<table>
<thead>
<tr>
<th>Three vignettes (Newspaper articles)</th>
<th>Extracted stories</th>
<th>Core physics concepts</th>
<th>Concept applications</th>
</tr>
</thead>
</table>
| “Teen Thrown in Air Holds on to Wires” | Jeep accident story | • Kinetic energy  
• Torque  
• Conservation of energy  
• Conservation of angular momentum  
• Gravitational potential energy | • Accident forensics  
• Moving car  
• Survivor stories |
| “Thousands Die as Quake-Spawned Waves Crash Onto Coastlines Across South Asia” | Christmas tsunami story | • Water wave velocity and propagation  
• Gravitational potential energy  
• Energy conservation in waves  
• Wave refraction and diffraction  
• Single-slit diffraction | • All waves (light, sound, TV, radio, quantum waves, etc.)  
• Energy in tectonic plates and waves |
| “7 Go on Trial Over Quake” | L’Aquila earthquake story | • Statistical fluctuations  
• Engineering  
• Geology  
• Earthquake waves | • Experts, fluctuations, and the law  
• Prediction of random events  
• Evacuations |
onts across South Asia” (Des Moines Register, December 28, 2004); and (iii) “7 Go on Trial Over Quake” (New York Times, September 21, 2011), which we refer to, respectively, as (i) the jeep accident story, (ii) the Christmas tsunami story, and (iii) the L’Aquila earthquake story. Table 2 lists three extracted physics stories, core physics concepts, and potential areas in which one could apply these concepts.

Discussion of articles

The article “Teen Thrown in Air Holds on to Wires” (Iowa State Daily, 2003) is a short piece in the student newspaper that covered how a teenager was catapulted 25 feet into the air after his Jeep swerved to avoid a car; the Jeep rolled over and over, possibly five times, before hitting a telephone pole. The teen was not wearing a seat belt, and, at the moment the top came off the Jeep, he was moving upward and grabbed onto telephone wires before being rescued.

The next article, “Thousands Die as Quake-Spawned Waves Crash Onto Coastlines Across South Asia” (Waldman, 2004), covered a 9.0 earthquake and the resulting tsunami off the western coast of Indonesia near Aceh the day after Christmas in 2004. The earthquake and tsunami inundated villages and towns throughout Southeast and South Asia, with reported fatalities in the thousands (later, fatalities were known to be in the hundreds of thousands). A wall of water 40 feet high washed on lands from Malaysia to Sri Lanka and as far as Africa, where nine people were reported killed in Somalia. A map showing the Philippines to Africa indicated the location of the earthquake and the outgoing tsunami wave traveling across the Indian Ocean.

The final article, “7 Go on Trial Over Quake” (Povedolo, 2011), discussed how seven prominent Italian earthquake experts were convicted of manslaughter and sentenced to 6 years in prison “for giving a falsely reassuring statement” that an earthquake was not imminent. Around the beginning of 2009, there were tremors, often 10 per day but sometimes just one or two per day. A commission of experts was formed and assured people on March 31 on television that a large quake was not likely. On April 6, a 6.3-magnitude earthquake struck; 309 people died and thousands were left homeless.

These newspaper articles are ideal because they do not look like science stories, but they contain and illustrate basic physics principles. The instructor studies and extracts those physics ideas that further explain and elucidate the newsworthiness, centering physics in these stories that previously lacked this context. The instructor then forms a narrative (a story that fits all the facts) and explains all the observations in the news story.

The instructor reads the article in class, usually in detail with comments, and proceeds to narrate the storyline with figures and physics explanations. At every opportunity, the instructor should take small detours to discuss the importance and understanding of conservation laws; the work-energy theorem; the connection between science, technology, and national well-being; and other relevant topics.

Newspaper Physics narratives

Newspaper Physics narrative for the Jeep accident story

This article is like a problem in accident forensics in that it is completely understandable if someone has an understanding of energy and angular momentum conservation. The Jeep had a kinetic energy on the road and, when it turned sideways, the friction force of the tires on the road generated a torque that caused the Jeep to roll over with a rotational kinetic energy equal to its kinetic energy. Its corresponding angular momentum remained constant as it rolled over at least five times. The 25 feet that the teen was thrown into the air illustrates gravitational potential energy, which is equal to the kinetic energy of the teen as he became free of the Jeep.

First, we read the article pointing out the physics issues and ideas we would discuss. In the article, the mention of the teen being thrown 25 feet in the air relates to gravitational potential energy. The car was seen rolling “over and over, possibly five times,” and this illustrates angular momentum conservation. The student did not have his seat belt on, so the force on him was zero ($F = 0$), and he could fly in whatever direction he was thrown. Finally, the comment that “his leg caught on one wire, and he grabbed for the other” and hung there for 20 minutes before the fire department arrived to take him down can lead to a discussion of probabilities: What is the likelihood that he survived without a scratch? One can talk about the psychology of survivors of wars and natural disasters and the stories they tell.

Following Feynman (2011), the style of the classroom discussion is to do what physicists always do when observing natural events: Make up a story that fits the facts. This story should be not too complicated and should respect all that is known and observed; if possible, it should predict something that was not previously observed.

The science covered in the article is illustrated in Figure 3. The Jeep (with mass $M$) was traveling at velocity $v$; because the Jeep turned sideways, the friction of the tires on the street provided the torque to start the Jeep rolling over. At this point, we simplify the way that physicists always simplify, by abstracting the essential part and neglecting the complications. (We can always come back
later and put in all the details.) So, we replace the Jeep with a cylinder of radius $R$ and tangential velocity $v$ (the same as the original velocity and the rolling-over velocity). This cylinder has angular momentum $L = \frac{1}{2} M v R$, which will remain constant (will not change) as long as no other torque is applied. Of course, some torque is applied every time the Jeep bounces on the street as it rolls along, but these are bouncing torques with forces that mostly go through the center of mass of the Jeep and will not change the angular momentum by much.

We make detours on familiar angular momenta, such as Earth’s rotation (length of day) and Earth’s orbit around the Sun (length of year). The Jeep hit a telephone pole, and the student (mass $m$) flew freely out the top in a vertical direction at the same tangential velocity $v$. It is now a question of how high the mass $m$ will go starting from ground level with velocity $v$. Energy conservation means that the sum of the kinetic energy ($KE = \frac{1}{2} m v^2$) and gravitational potential energy ($GPE = mgh$) must be constant, so at ground level ($h = 0$ and velocity $v$), $KE + GPE = \frac{1}{2} m v^2 + 0$ and at the top ($h = 25$ feet and $v = 0$), $KE + GPE = 0 + mgh$. This equality gives $\frac{1}{2} m v^2 = mgh$. The mass $m$ is canceled on both sides of this equation, and by doing a little algebra, we calculate that $v = 12$ meters per second or about $v = 27$ miles per hour. Usually in this course we try to avoid algebra, but in this case it is worth the effort.

The comment that “he was not wearing a seat belt” leads to a discussion of the reason for seat belts (to prevent you from becoming a freely flying object), why cars have “crush zones” (to absorb an impact slowly over a longer distance to allow the force on the passenger to be smaller), and why seat belts are used in airplanes.

**Newspaper Physics narrative for the Christmas tsunami story**

Images of the wave fronts of the tsunami appeared in most newspapers, labeled by the hour after the earthquake. The remarkable wave front map in the *Des Moines Register* (derived from the National Oceanic and Atmospheric Administration map shown in Figure 4) displays all important wave phenomena: wave front map of the “Christmas tsunami” that propagated across the Indian Ocean to Africa, around India to Pakistan, and south to Jakarta. The map shows wave velocity, wave refraction near the shoreline where the velocity is lower, single-slit diffraction in the narrow channel between Sumatra and Jakarta, and wave diffraction around the Indian peninsula.

It is easy to see from the scale that the wave was traveling at about 500 miles per hour. All waves have the same properties: They have a velocity in a medium, they refract going from one medium into another, and they diffract around obstacles and through narrow openings. The wave velocity is proportional to the square-root of the depth, $v = \sqrt{gd}$, where $g$ is the acceleration of gravity, $g = 10$ meters per second per second, and the depth, $d$, is about 5,000 meters. The wave front propagates 500 miles every hour, as seen in Figure 4, and this velocity of 500 miles per hour is nearly constant all across the Indian Ocean. Near the shore, the velocity drops because the water is less deep and the waves refract toward
FIGURE 4
Wave front map.


the normal (just like refraction in an optical lens); therefore, the wave front approaches perpendicular to the shore. The wave diffracts about India and heads toward Pakistan, and it refracts around Madagascar and heads through the channel between Madagascar and Africa. The wave front that impinges on the narrow channel between Sumatra and Jakarta emerges on the other side as a spherical wave, an example of single-slit diffraction. All of this is illustrated by discussing refraction, diffraction, and wave velocity in optics and lenses, making these wave phenomena more accessible and understandable.

Newspaper Physics narrative for the L’Aquila earthquake story

The L’Aquila earthquake in the mountains east of Rome on April 6, 2009, killed 309 people. Of course, this region of Italy, as in most of Japan, has experienced thousands of small tremors and occasionally large quakes for all of known memory, and the people of the region have developed habits to mitigate the loss of life: They sleep outdoors during these periods, as they did during the 3-month period between January and April 2009, in which there were repeated bursts of small tremors. A commission of experts was called upon to comment. The commission met on March 31, 2009, and they said on television that they had concluded that a large earthquake was not imminent. The 6.3-magnitude quake happened 1 week later, and the scientists were charged, prosecuted, and convicted of “multiple manslaughter for giving a falsely reassuring statement” (Povoledo, 2011, p. A6).

There are many issues to discuss. Technically, there are the physics and geology of earthquakes, sensing and monitoring, attempts to predict them, costs of earthquakes and evacuations, and the engineering of structures. Socially, there is psychology, the perception of risk, and human emotion. Legally and economically, there is the law, which includes compensation for loss, guilt and innocence, and how to weigh “acts of God” against human suffering and loss. Statistically, any judgment about future events rests on probabilities based on previous measurements of events and the likelihood of occurrences of random events.

This whole episode, starting with the original article on April 6, 2009, is a story without bounds. It combines science and technology, sociology and psychology, the law and society, human emotion and tragedy, and economics and risk. Students are asked to write a “reflection” piece on stories like this. The questions raised are far-reaching and largely unanswerable, but they require thought. What do you do if scientists claim that San Francisco will experience a huge quake during the following month? Evacuate the city? Encourage people to take vacations? Even a simple evacuation can lead to panic and cost billions of dollars.

The New York Times article in April 2009 shows 3 months of data on the number and magnitude of all the tremors. In addition to all the other legal and social issues, one can discuss statistics, periodicity, statistical fluctuations, and the current state of earthquake prediction.

Findings from student evaluations

Two focus groups were interviewed in detail, one a single class (so the students all knew one another) and the other a mixture of students from different semesters over 3 years (approximately 15 to 20 students per
FIGURE 5

Results from the descriptive analysis of the survey data.

In addition, four different sets of survey questions were formulated and given by mail to Newspaper Physics students ($n = 29$) and to one section each of Physics 101 ($n = 11$) and English 105 ($n = 26$). Two sets of 19 questions related to physics learning were sent to the students in the Newspaper Physics and Physics 101 courses. Two sets of 15 questions related to written communications were sent to the students in Newspaper Physics and English 105.
The descriptive quantitative analysis of the survey data, (see Figure 5) demonstrates that in all items, Newspaper Physics ranked at or above a typical course. Specifically, students in Newspaper Physics reported that they gained higher physics content knowledge, higher-order thinking skills, more opportunities to work with peers outside class, and greater confidence in seeking help and understanding science as compared with students in Physics 101. Similar results were also found from students in English 105. Students in Newspaper Physics reported increased English content knowledge and more confidence in asking questions and communication skills.

Based on focus group data and our reflections as instructors, we discovered four major themes from Newspaper Physics (both single classes and longitudinal groups over 3 or 4 years).

**Interdisciplinary learning as synergistic (from good at writing or physics to good at both)**

First, students seemed to mitigate their physics and math anxiety while maximizing their feelings of being good at writing, or vice versa, within the interdisciplinary learning and teaching environment. Here are two representative quotes:

*A lot of people were taking [the course] because they don’t like physics, and they are pretty good writers. I am not a very good writer, but I like physics.*

*For me, it was the last science credit I needed, and I thought it was a good way to do it, because I hate math. It was a good way to learn more about physics without having to do a lot of math.*

**Physics content as current and big ideas (from fear to fun)**

Students’ initial fear with writing, physics, or math seemed to be dispelled due to the inherent nature of the science curriculum material. They reported that learning physics ideas as big ideas that were contextualized in real life made learning fun and helped them make sense of the concepts. Here are two quotes:

*One of the things that helped me learn was that we focused on things that were current and fun.*

*My favorite thing was when we talked about the nitro ice cream. We learned about how they used the conductors. They had just opened up a shop in Ankeny, where I live. I actually ended up working for them at the fair last summer. It was interesting.*

The most mathematically complicated physics concepts are completely out of reach of a layperson. But [the instructors] condensed it down to what [they] thought we’d care most about. We could all visualize that, but I am sure it is not quite that simple.

Because it is so basic, you can apply the concepts to a lot of things.

**Instructional model as porous (from meeting expectations to thinking critically)**

Students could experience physics learning that is more holistic, open-ended, and dialogical. Unlike memorizing facts or formulas, the instructional model seems to encourage varied modes of participation (e.g., discussion, communication, self-critiquing, interviewing) and formative assessments that were staged along with ongoing feedback. Here are a few student quotes:

*At first, I thought that all classes would be like this. It took a while for me to come down.*

*This class is not focusing on regurgitation and rudimentary memorization. That was really appealing to me at the time. All the other classes at that point in your career are just like that: Here’s the information, memorize it, and know how to use it within these guidelines.*

*I remember being so excited that we didn’t have any quizzes or tests. I didn’t know how they were going to grade us.*

*Kids were sitting back and raising their hands to ask questions. In other classes, you are writing it down so much, you are just trying to grasp it. You don’t have time to really think, because you know you have to get it all down for homework. But in this class you had freedom to think for yourself and ask your own questions. It was a new thing that we had to get used to for a while.*

*A lot more thinking and pondering. It was a different thought process. It made me wonder why all the courses couldn’t be like that. It helped you to strive to write a good paper that others would appreciate rather than just meeting the instructor’s requirements.*
Learning environments as safe, diverse, and connected (from comfort zone to community zone)

Finally, Newspaper Physics seemed to provide safe and diverse learning environments. Consequently, students seemed to feel connected and had a sense of community such that they started to shift from a comfort zone to a community zone, as well as from a controlled environment to a free environment in which they could be independent thinkers.

We felt like a huge family ... no competition. Having the different opinions on how you could have structured it differently was helpful. Peer revisions provided for extra ideas. I tell any freshman that comes my way that they have to take this class. ... A lot of us have had many of the same classes, so we’ve developed an even bigger bond.

Every time you went to class, almost everyone was there. People would even show up early and stay after to talk more with each other or with the professors.

I thought it was great compared to other classes. I think our class was probably one of the most close-knit classes I’d ever been in. Everybody would say “hi” to each other on campus. I loved that aspect of it.

Lessons learned and conclusions

Newspaper Physics seems to provide first-year college students the combination of relevance, currency, and community that is demanded in an ever-changing world with an abundance of information, as well as in the diverse and innovative STEM workforce. A typical good newspaper contains a couple of paperback books’ worth of text every day. Newspaper topics are timely, and relevant contents are constantly updating and changing. Prominent newspapers around the world, such as Le Monde, New York Times, Los Angeles Times, and The Guardian, have large staffs and foreign reporters, and these newspapers seem to be “ahead of the curve” in maintaining their readership and subscribers.

This current and contextualized information draws students’ attention to its direct relevance to events today, as well as possibly the impact of past events on current events, and this teaching method can be used in chemistry, mathematics (Paulos, 1995), the arts, statistics, biology, psychology, geology, political science, history, and other subjects. For example, in history, any mention of Afghanistan could lead to watching the film Charlie Wilson’s War with Tom Hanks, and students could be asked to look up and fill in the history of Afghanistan, from its Pashtun roots to Alexander the Great to the Soviet invasion to the U.S. war against the Taliban. In almost every current news political article, you can ask, “What has been left out of this article?” There is a mountain of information to be found. In addition, the obituaries of political leaders and scientists are fascinating and often offer a unique view of history.

This manner of teaching would require more of the instructors, but considering the value of being able to google almost anything, the curriculum control by a teacher can be distributed to and co-developed with the students (who would benefit) by asking them to investigate the claims in an opinion piece or to compare two contradictory points of view, both of which may be wrong. This level of critical thinking is essential to any democratic society and a skill that seems to be missing among much of our citizenry. Therefore, college students early on can be inspired to be producers of knowledge and responsive citizens as opposed to consumers of knowledge and reactionary citizens. Each semester, we encouraged our first-year college students to send an opinion article to a local or state newspaper; although not in significant numbers, a few students have taken these extra steps.

Finally, the performance-based assessments used in Newspaper Physics such as portfolios, writings, and oral presentations seem to promote the first-year college students’ metacognition, which is a central part of one’s innermost intellectual life. Omidi and Sridhar’s (2012) study indicated that performance assessments, regardless of a student’s gender, had a positive impact on all dimensions of metacognitive skills, such as planning and monitoring one’s own cognition, cognitive strategies, and awareness of one’s own progress. Amid the traditionally prescribed college curriculum and GPA-based controls, first-year students can still be freed to engage in higher-order thinking while learning fundamental physics ideas. The newcomers in Newspaper Physics, a course that serves as a small step toward a humanistic approach to learning physics, seemed to maximize their first-year college lives, not only with regard to their intellectual growth but also with regard to how they learn to relate to others as critical friends, which afforded a sense of belonging.

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References

E. J. Bahng (ejbahng@iastate.edu) is an associate professor in the School of Education, John Hauptman is a professor in the Department of Physics and Astronomy, and Jennifer Lowery is an instructor in the Department of English, all at Iowa State University in Ames, Iowa.