Today’s undergraduates are highly engaged in a variety of social media outlets. Given their comfort with technology, we wondered if we could use this phenomenon to teach science-related material. We asked students to use freeware to make a short video with text, images, and music as a way to explain scientific concepts that are traditionally difficult for them to apply. Students demonstrated proficiency with the new technology, despite limited prior experiences. The process of making a video seemed very personal and meaningful to them as many used life experiences to demonstrate the concepts. They engaged in science conversation with friends outside of the classroom and wanted their videos utilized in future classes as a teaching tool. Our data underscore the impact social media has on student engagement and learning of scientific concepts that goes beyond the traditional means of writing or reporting. This article describes our approach, its impact on student learning, and its applicability for teaching a variety of scientific concepts.
haps the newest specific multimedia application. It offers a creative opportunity for students to choose music, images, text, and animation to create their own videos. However, despite the fact that undergraduates are increasingly comfortable with using technology (McHale, 2005), several barriers could preclude the successful use of digital video technology in college classrooms. For instance, given the experience students have with exploring social media, does this extend to experience with video-making technology? Does digital video making appeal to students? Would they be engaged by a digital video-making project and, if so, would it translate to increased learning of course material and sharing of ideas? We required students to create a digital video using video-making freeware that can be used on any PC or Mac computer. They were assigned one of two concepts, either neurotransmission or the scientific method, that are traditionally difficult for them to apply. We hypothesized that the video project would yield student perceptions of engagement in this activity because it offered attributes (music, images, text, animation) that students use routinely in a social media context. Additionally, we hypothesized that the video project would increase student learning because of its multimodal approach to breaking down and applying concepts.

**Method**

**Participants**

Participants in this study were traditional students (N = 56; 46 females, 10 males) attending a small liberal arts college in the northeast United States. They were enrolled in two separate sections of a 14-week, lecture-based science course, Physiological Bases of Behavior, which is required as part of the neuroscience concentration. It typically attracts sophomore biology, chemistry, philosophy, and psychology students. Each section was taught by the same professor and met two days a week (at different times of the day) for 75 minutes in the same classroom. All final student grades were determined by performance on a prerequisite “mastery quiz” (7%), an oral presentation on brain disorders/diseases (7%), two tests (29% total), a video project (14%), a video response paper (7%), lecture prequizzes and homework (14%), and a cumulative final exam (21%). The video project and response paper were new additions to the course.

**The video project**

The video project was designed to assess one of six learning objectives listed in the syllabus: “Students will be able to simplify complex information so that it is understandable to a general audience.” It required that students use digital video technology to demonstrate their ability to accurately apply either the concept of the scientific method or neurotransmission to a topic of their choice. One section of students (N = 29; 24 females, 5 males) was assigned the scientific method (SM), hereafter called the SM group. The other section (N = 27; 22 females, 5 males) was assigned neurotransmission (NT), hereafter called the NT group.

Students were required to create a 3- to 5-minute video, with one music song, multiple images, and simplified text (animation was voluntary), using one of several freeware video editing software programs including Windows Movie Maker (Microsoft), Windows Movie Maker Pro (Microsoft), or iMovie (Apple). Students were given approximately five weeks to complete this project and were expected to work individually, using a tutor or the professor as possible resources. The final video was submitted to the professor as a CD or a DVD. The video project consisted of four phases (Figure 1).

**Phase 1 (lasting one week)**

Students first received written goals for the video project. A categorical rubric was used to link 10 specific assessments (using an evaluation of excellent, good, fair, or poor) to these goals, as follows:

A. To link and apply the SM or NT concept to a topic in physiological psychology:
   1. SM or NT steps are accurately represented.
   2. SM or NT is linked clearly to topic.
   3. Distinct steps of the SM or NT are applied accurately to topic.
   4. Topic is clearly defined with information to aid understanding by a naïve audience.
   5. Depth of topic goes beyond common knowledge, sources are cited in the video.

B. To organize a logical and creative video:
   6. Information flows logically.
   7. Slides/frames are used effectively and with purpose.
   8. There is evidence of creativity.
   9. To develop “detail” skills where

**FIGURE 1**

Schematic showing the timeline and activities for each of the four phases of the study.
Second, the professor presented an in-class discussion of the project expectations and timeline. Finally, an out-of-class freeware tutorial was provided by an upper-class student with a technology background who had performed very well in the course in a previous semester.

**Phase 2 (lasting three weeks)**

Students were encouraged throughout the following several weeks to share their topics with the professor and to seek advice from the tutor or professor if needed. Approximately 28 days after beginning Phase 1, all videos were submitted to the professor for grading (see Tables 1 and 2).

**Phase 3 (lasting one week)**

Students were given an additional week to submit a response paper detailing their perceptions of the project. The response paper included 31 questions (several were derived from Quinn, 2006) related to the project (see Figure 2 for the response paper instructions used for the NT group). No video scores were released until all response papers were submitted.

**Phase 4**

All students completed a cumulative final exam designed to evaluate the cumulative learning that occurred throughout the semester. The final exam contained embedded assessments of the SM and NT concepts (see Appendices A and B). A detailed rubric was used by a single grader who was trained in its usage but blinded to the student groupings. All final exam scores were analyzed with SPSS for Windows (Version 16) statistical software program. Comparisons of means from the different sections (SM and NT) were evaluated by independent *t* tests. For all statistical tests, *p* < .05 was considered statistically significant.

**Results**

The topics chosen by students represented many disciplines in science.

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**TABLE 1**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Music choice artist/year</th>
<th>Step 1 Observe a phenomenon</th>
<th>Step 2 Ask a question</th>
<th>Step 3 Make a hypothesis</th>
<th>Step 4 Make a prediction</th>
<th>Step 5 Further observation and experimentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class example: Squirrel behavior</td>
<td>Squirrels chase students across campus to their classrooms.</td>
<td>Why do squirrels do that?</td>
<td>Squirrels are hungry, and they chase students who have food in their pockets.</td>
<td>If you put food in the pockets of students, then squirrels will chase them.</td>
<td>Observe squirrel behavior when students pass by with or without food in their pockets.</td>
<td></td>
</tr>
<tr>
<td>Student example #1: Color and physical attraction “She Will Be Loved” by Maroon 5, 2002</td>
<td>Females who wear brighter clothes seem to get approached more at parties.</td>
<td>Why do they get approached more?</td>
<td>Females who wear red clothes are seen as more attractive than those who wear gray clothes.</td>
<td>Photographs of females wearing red will cause physiological changes in the viewers of the photographs.</td>
<td>Observe physiological responses of participants when they view photographs of females wearing red or gray.</td>
<td></td>
</tr>
<tr>
<td>Student example #2: Ganglioglioma brain tumor “Fix You” by Cold Play, 2005</td>
<td>MRI showed signs of a ganglioglioma tumor.</td>
<td>Were these seizures happening because of the ganglioglioma tumor?</td>
<td>Surgical removal of the tumor will cause the experienced seizures to decrease or stop entirely.</td>
<td>If a tumor is the cause of seizures, then surgical removal should eliminate the seizures.</td>
<td>Further observations since the tumor was removed in 2004 show that seizures have ceased to date.</td>
<td></td>
</tr>
<tr>
<td>Student example #3: Bikram yoga “Fever” by Michael Buble, 2003</td>
<td>Dedicated Bikram yogis habitually expose themselves to rigorous and potentially dangerous conditions.</td>
<td>Why do yoga students become dedicated practitioners of the Bikram method when it is like an inferno?</td>
<td>Bikram draws dedicated yogis because of the stress-relieving benefits of the method.</td>
<td>Bikram will cause the release of lower levels of stress hormones.</td>
<td>Compare stress hormone levels in groups of Bikram practitioners and nonpractitioners.</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Music choice represented the longest song in the student video. SM = group of students who were assigned the scientific method.*
Differing numbers of students from each section shared their topics with the professor, sought out tutor help, or met face-to-face with the professor (SM = 79% of students, NT = 30% of students). There was no evidence that this was a gender-based phenomenon; rather, it was more likely that SM students had a harder time conceptualizing the scientific method. All videos submitted met the time criterion of 3 to 5 minutes (SM mean = 3 minutes and 57 seconds, NT mean = 3 minutes and 44 seconds). Musical selections transcended all genres and time periods (2.7 songs/student video) and a subset of students included animation in their videos. Although no videos or response papers were turned in late, two students required extra time to resubmit their videos in a format compatible with the professor’s computer.

Student perceptions of the video project

On the basis of data from the response papers, 98% of all students had their own computer, most for at least one year. Nearly all students had video-making freeware already installed on their computers and reported how useful technology was for learning, yet most had little to no experience using this technology (Figure 3). They also felt strongly that “hands-on” projects were beneficial for them, yet our evidence suggests that more guidance was needed for some of them to initiate this project; feelings were mixed about the sufficiency of class time dedicated to initial discussions of the project (Figure 4). They preferred to choose the topic instead of having a topic chosen for them by the professor (SM = 66%, NT = 70%). After the process of creating a video, 77% felt that the software was easy to use and 98% believed that they had enough time to complete the project.

With regard to perceived learning, students believed that (1) they better understood their concept (SM = 93%, NT = 93%), (2) breaking the concept down helped in their understanding (SM = 82%, NT = 85%), (3) they could list the steps in the scientific method (SM = 96%) or neurotransmission (NT = 96%), (4) they could explain their topic to a non-science friend (SM = 100%, NT = 93%), and (5) they could apply the information they learned to another course (SM = 93%, NT = 85%). There was evidence that their peers could benefit from this assignment. Most students (78%) thought that the professor should use videos like theirs to teach the class, and nearly all (96%) thought that other students would learn something from watching their video. It is impor-

<table>
<thead>
<tr>
<th>TABLE 2</th>
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<tbody>
<tr>
<td><strong>Student examples from the NT group (all data taken from student videos).</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic</th>
<th>Presynaptic neuron activity</th>
<th>Neurotransmitter release</th>
<th>Receptor bound, reuptake, or enzymatic degradation</th>
<th>Postsynaptic neuron activity or outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class example:</strong> Alzheimer’s disease</td>
<td>Viability and activity of presynaptic neurons are compromised.</td>
<td>Less acetylcholine is available in the synaptic cleft.</td>
<td>Less receptor binding on the postsynaptic neuron occurs.</td>
<td>Postsynaptic neuron activity is reduced.</td>
</tr>
<tr>
<td><strong>Student example #1:</strong> Alcohol “Blame It” by Jamie Foxx, 2009</td>
<td>Presynaptic neuron is active.</td>
<td>GABA is released from the presynaptic neuron.</td>
<td>GABA binds to GABA receptors, which are kept open longer by alcohol binding, allowing more Cl to enter the cell.</td>
<td>Postsynaptic neuron is hyperpolarized and takes longer to achieve an action potential to communicate with other neurons.</td>
</tr>
<tr>
<td><strong>Student example #2:</strong> Ecstasy “The Adventure” by Angels and Airwaves, 2006</td>
<td>Presynaptic neuron is active.</td>
<td>Serotonin is released from the presynaptic neuron.</td>
<td>Ecstasy binds to serotonin transporters and minimizes reuptake so that more serotonin remains in the synaptic cleft.</td>
<td>Excess amounts of serotonin in the synaptic cleft causes feelings of euphoria.</td>
</tr>
<tr>
<td><strong>Student example #3:</strong> Depression “Rhinestone Eyes” by Gorillaz, 2010</td>
<td>Presynaptic neuron is active or moderately active.</td>
<td>Insufficient amounts of epinephrine, norepinephrine, and dopamine are released from presynaptic neurons.</td>
<td>Insufficient levels of these neurotransmitters in the synaptic cleft make it less likely that receptor binding will occur.</td>
<td>Insufficient levels of these neurotransmitters can disrupt sleep, appetite, and mood.</td>
</tr>
</tbody>
</table>

Note: Music choice represented the longest song in the student video. NT = group of students who were assigned the concept of neurotransmission.
Response paper instructions.

Answer all portions of each question below. Points will be awarded based on the completeness of your answers. This includes providing rationale! There are no correct answers that you must write to earn credit, however, all questions must be answered. Please be honest. Submit your finished work to me digitally. The deadline for this assignment is by the start of class on __________.

A. Background information
1. Do you have your own computer? How long have you had it?
2. Do you currently have a PC or Mac? Is it a laptop?
3. Do you think that the use of technology can enhance learning? Provide an example.
4. State how much experience (a lot, some, a little, none) you have had in using video-making software (e.g., Windows Movie Maker or iMovie) prior to this project. If you have had experience using video-making software, please discuss. If you have had little experience, why is that?
5. Did you have video-making software already installed on your computer? If not, how did you access video-making software for this assignment?
6. Was the software you chose easy to use? Why or why not?
7. Just curious, what do you like best about computers in general? What do you like least?

B. The project experience
1. Was the evening tutorial on Windows Movie Maker useful for you? Why or why not?
2. Was there adequate technical support for you to do this project? If not, how did you get help?
3. Did you have adequate time outside of class to work on this project? Elaborate.
4. Would you prefer to have the professor assign a topic to you or to have your choice of topics? Why?
5. What was the most difficult part of this video project for you? Elaborate.
6. In your opinion, what would be the best way to do this video project in the future?

C. Neurotransmission
1. Do you feel that you better understand neurotransmission?
2. If you had to, could you draw and apply the concept of neurotransmission off the top of your head?
3. Could you explain it to a friend with limited science background? What example would you use?
4. What was the most frustrating part of aligning your topic to neurotransmission?
5. Do you feel confident in applying neurotransmission to another course? What course and how?
6. Same as #6 above, except to another aspect of your life? If so, what other aspect?

D. Your learning
1. Do you feel that this video project in any way influenced your education? Why or why not?
2. Comment on your understanding of your topic of choice before and after the video project.
3. Do you believe that having to break your topic down into a video influenced your understanding of the topic? If so, how? If not, why not?
4. Do you believe that a “hands-on” project like this is beneficial for you? Why or why not?
5. Would you be willing to create a video project again for a class? Why or why not?
6. Would you want to have more or less class time devoted to making videos? Why?

E. Thoughts—please be as specific and descriptive as possible.
1. Would you like to have a professor use videos like yours in lecture to illustrate a concept other students need to learn? Why or why not?
2. As a future student in this class, would you be interested in viewing short videos online, like the one you created, as part of outside of class preparation? Why or why not?
3. Would other students learn anything from your video if they viewed it? What would they learn?
4. Did you talk to any of your friends about this video project? Briefly summarize those conversations.
5. What career do you hope to pursue? Will video-making skills, like those you learned here, be useful?
6. Discuss something about this assignment that surprised you.
not take me as long as I would have thought”
• “Proud of my work after being stressed”
• “It was a lot easier and more fun than I thought it was going to be; that I enjoyed it”
• “How time-consuming it would actually turn out to be; how long it took to put all of the images together, and make it flow well”
• “How much I was able to learn”

Clearly, students were quick to learn and understand the software, yet the construction of this short video was more time consuming than they thought it would be. Notably, the SM group was more likely to seek out nontechnical help from resources, indicating a difference in the understanding of the two scientific concepts to begin with. Whether this was related to gender is unknown (our sample was predominantly female) and will be a useful area for future research.

**How project contributed to increased learning**

Our video-making project required students to research, organize, and reflect on class information. It was the tool we used to increase student learning because it used multimodal (visual, auditory), social (sharing with friends), and individual (choice of topic, creativity) learning strategies. Many factors could have enhanced their learning. A short list includes image selection, musical selection, optimal text usage, time-on-task spent in breaking down the assigned concept, engagement, and even the reflective writing of the response paper. Future investigations into this area of research will tease apart the effects of these different factors on learning. For instance, there is no doubt that this project required a significant amount of time for students to complete. In this regard, it was a bit like a research paper project, a “tried and true” method used to encourage learning. Yet, different from a paper, making and editing videos required the linkage of visual and audio media. In essence, students defined their understanding of the concept with visual and audio representations, which was an additional step from writing. It is unclear whether time spent on a task is a meaningful indicator of learning.

**FIGURE 3**

Student self-report data showing the amount of experience they had with video-making freeware. SM = group of students who were assigned the scientific method. NT = group of students who were assigned neurotransmission.

**FIGURE 4**

Preference for the amount of class time that should be used for this project. SM = group of students who were assigned the scientific method, NT = group of students who were assigned neurotransmission.
FIGURE 5
Percentage of students who talked to their friends about the video assignment. SM = group of students who were assigned the scientific method, NT = group of students who were assigned neurotransmission.

![Bar chart showing percentage of students who talked to their friends about the video assignment. SM group is shown in gray, NT group in black.](image)

FIGURE 6
Direct measure of student learning (embedded assessments on final exam) showing that the SM group performed significantly better on scientific method assessment questions, the NT group performed significantly better on neurotransmission questions, and the SM and NT groups performed similarly on concepts not assigned in the video project. SM = group of students who were assigned the scientific method, NT = group of students who were assigned the concept of neurotransmission. **p < .05.

![Bar chart showing scores earned (out of 100%) on final exam. SM and NT groups are compared with a cumulative group (CUM).](image)

particularly in a video-making context. It would be very interesting to assign a concept, hold “time on task” constant, and compare the effectiveness of established (writing a report) versus novel (making a video) approaches for gauging student learning. One could argue that students of this generation have different needs than those of previous generations.

**Novelty and adaptability**

This video project lends itself well to virtually any science course. It requires students to break down a concept and apply it to a specific topic. In our case, we first identified concepts that students routinely struggle with. We then designed the project, keeping in mind several factors that might appeal to undergraduate students. First, the video was relatively short, with music to reinforce images and words. We thought that adding music to the video might make it more personal for them. Second, students chose a topic of interest related to physiology from which to apply their assigned concept. This was intended to personalize the project because students who take this science course have varied backgrounds and interests. Third, we chose video-making software offered by Microsoft and Apple because they were either already installed on student computers or free to download. Fourth, we developed expectations that would challenge students of all talent and motivational levels. With this strategy, exceptional students who may have already mastered their assigned concept could still put their efforts into optimizing their video as a teaching tool for others.

There was no evidence that students worked together on videos. Because a hard copy of each video was turned in to the professor, it was easy to organize them by topic and make them available for review if an investigation for plagiarism was required later. Plagiarism of web resources was also not an issue, likely
because of a short tutorial provided on that topic earlier in the semester.

**Suggestions for improvement**

Students offered insightful comments to improve the project, and several themes emerged that should be taken into consideration. A few suggested doing the project in groups. We wanted to eliminate the influence of other peers in the learning process, especially because the bulk of the work was completed outside of class. In our experience, group projects can yield inequitable workloads that, in this case, could influence the degree of individual “hands-on” experience. Also, we wanted to place value on individuality and creativity in this project. Other interesting extensions of this project were suggested. For instance, one student thought it would be a good idea to “show other videos after they were completed,” whereas another offered the suggestion to “make a mini-film festival where everyone shows their videos.” Because the video was due at the end of the semester, it was not possible to implement these thoughtful ideas. Perhaps most important, the strategy we report can be modified easily by teachers for use with virtually any topic/concept of interest. Students need only a standard computer onto which freeware can be added. It will be interesting to see whether “hands-on” learning takes on a whole new meaning as we transition into the future.

**Summary and conclusions**

Our report underscores the impact technology use can have on college student learning. We document that technology use can have on college learning of video-related concepts. Several barriers that could have compromised the effectiveness of our approach never materialized. Digital video making appealed to students, and they were highly engaged with the video project despite having little significant experience with the technology to begin with. They demonstrated quick proficiency in the use of novel technology, perhaps because it tapped into skills that are a routine part of social media platforms. This translated into conversations with peers about their videos while increasing learning of course material. Perhaps most important, the strategy we report can be modified easily by teachers for use with virtually any topic/concept of interest. Students need only a standard computer onto which freeware can be added. It will be interesting to see whether “hands-on” learning takes on a whole new meaning as we transition into the future.

**References**


**Michael Keith Jarvinen** (jarvim@emmanuel.edu) is an associate professor and **Danielle N. Sheehan** is a student, both in the Psychology Department at Emmanuel College in Boston, Massachusetts. **Lamis Zaher Jarvinen** is a visiting assistant professor in the Biology Department at Mount Holyoke College in South Hadley, Massachusetts.
Appendix A: Embedded NT assessment questions on the final exam.

<table>
<thead>
<tr>
<th>NT questions (multiple choice)</th>
<th>Correct answer</th>
<th>Incorrect possibility</th>
<th>Incorrect possibility</th>
<th>Incorrect possibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>The part of the neuron that receives information and carries information to the cell body is the:</td>
<td>Dendrite</td>
<td>Soma</td>
<td>Axon</td>
<td>Terminal button</td>
</tr>
<tr>
<td>The small gap that exists between adjacent neurons is called the:</td>
<td>Synaptic cleft</td>
<td>Somal cleft</td>
<td>Axon hillock</td>
<td>Myelin sheath</td>
</tr>
<tr>
<td>A resting potential is:</td>
<td>the tiny electrical charge that exists when a neuron neither receives nor sends information</td>
<td>an electrical signal that travels along the axon of a neuron</td>
<td>the small gap that exists between adjacent neurons</td>
<td>an electrical signal that travels along the dendrites of a neuron</td>
</tr>
<tr>
<td>______ is when an action potential “jumps” from node to node along an axon.</td>
<td>Saltatory conduction</td>
<td>The sodium-potassium pump</td>
<td>“Fight or flight”</td>
<td>Firing threshold</td>
</tr>
<tr>
<td>An action potential is:</td>
<td>an electrical signal that travels along the axon of a neuron</td>
<td>the tiny electrical charge that exists when a neuron neither receives nor sends information</td>
<td>the small gap that exists between adjacent neurons</td>
<td>an electrical signal that travels along the dendrites of a neuron</td>
</tr>
<tr>
<td>The neural impulse is transferred to the next neuron via:</td>
<td>neurotransmitters</td>
<td>interneurons in the synapse</td>
<td>the myelin sheath</td>
<td>the sodium-potassium pump</td>
</tr>
<tr>
<td>Which of the following is not a characteristic of an action potential?</td>
<td>myelination of an axon</td>
<td>firing threshold</td>
<td>absolute refractory period</td>
<td>all or none</td>
</tr>
<tr>
<td>Assume a resting potential of –65 mv and then choose the best answer. Hyperpolarization is to depolarization as</td>
<td>–70 mv is to –60 mv</td>
<td>–60 mv is to –70 mv</td>
<td>60 mv is to 70 mv</td>
<td>70 mv is to 60 mv</td>
</tr>
</tbody>
</table>

NT question (short answer)

Sketch out an accurate diagram depicting neurotransmission between two typical neurons as we have discussed in class (label the neurons “A” and “B”). In the diagram, use 25 “neuron” terms to describe the process of neurotransmission or identify morphologically relevant parts of the neuron. Use the terms as labels (arrows work great). The diagram should speak for itself. No sentences allowed. Each missing term (less than the expected 25 terms) will result in a deduction of 1 point.

Sample correct answer options: Soma, resting potential, dendrite, dendritic spine, ion channel, Na+, K+, Cl−, EPSP, IPSP, firing threshold, axon, axon hillock, myelin, nodes of Ranvier, saltatory conduction, action potential, terminal buttons, neurotransmitter, reuptake, enzymatic degradation, receptor binding, receptor, hyperpolarization, depolarization, synapse, synaptic cleft, oligodendrocyte, temporal summation, spatial summation, presynaptic neuron, postsynaptic neuron

Note: NT = group of students who were assigned the concept of neurotransmission.

Appendix B: Embedded SM assessment questions on the final exam.

<table>
<thead>
<tr>
<th>SM question (short answer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply the scientific method to the following situation.</td>
</tr>
<tr>
<td>You have been offered a cool $210,000 to help a consulting firm develop examples of the scientific method in action. Essentially, they are asking you to take them through each step of the scientific method as you work through a sample topic (see below). The only guidelines you have been given are as follows:</td>
</tr>
<tr>
<td>• The topic is confined to music and its physiological effects on humans. You are expected to narrow this topic down to something more specific.</td>
</tr>
<tr>
<td>• You must apply each of the steps of the scientific method to this topic.</td>
</tr>
<tr>
<td>• Signposting each step is crucial (Step 1, Step 2, etc.).</td>
</tr>
<tr>
<td>• They are very interested in how the final step is discussed. In other words, details and outcomes of the final step must be specific, with statements that relate to future decisions.</td>
</tr>
</tbody>
</table>

Note: SM = group of students who were assigned the concept of the scientific method.