Weekly Reports

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WHY USE WEEKLY REPORTS?

Weekly Reports provide rapid feedback about what students think they are learning and what conceptual difficulties they are experiencing.

WHAT IS A WEEKLY REPORT?

Weekly Reports are papers written by students each week, in which they address 3 questions:

- What did I learn this week?
- What questions remain unclear?, and
- What questions would you ask your students if you were the professor to find out if they understood the material?

WHAT IS INVOLVED?

Instructor Preparation Time: Minimal. Questions may be written on blackboard or provided in hard copy form.
Preparing Your Students: Students need explanations on the purpose of the reports and training on structuring the answer to the first question.
Class Time: None; done at home.
Disciplines: Appropriate for all.
Class Size: Any class size. In recitation sections, Teaching Assistants grade the reports and provide feedback.
Special Classroom/Technical Requirements: None.
Individual or Group Involvement: Individual.
Analyzing Results: Reports need careful grading. The instructor should find a way to answer atypical responses individually and typical responses in class.
Other Things to Consider: Students must see how reports help them learn; otherwise, the reports will not be taken seriously.

Contents

Description

A Weekly Report is a paper that students write analyzing and reflecting on what they have learned. It consists of three questions that students answer: *(1) What did I learn this week?, (2) What questions remain unclear?, and (3) What questions would you ask your students if you were the professor to find out if they understood the material?*

Example 1: General Physics

1. What did I learn during Week #?

Physics consists of several major topics of which include: mechanics, heat (molecular physics), electricity, optics and atomic and nuclear physics. So far, we have started covering mechanics, the study of motion or the change of a position of an object with respect to another motion. When we speak of motion we should follow two models: one regarding dimensionless objects and the other regarding reference frames.

Dimensionless objects are objects whose size are less then the distance they covered. The second model states that we always need a frame of reference, For example, it would be silly to say a person sitting down is not moving. The reason for this is that the person is really moving in reference to perhaps an astronaut standing on the moon since he/she is standing on Earth, which is continuously moving. However, the person sitting down is not moving in reference to the ground. Therefore, we should always mention in reference to what we're talking about, in other words, a reference frame.

We are currently studying kinematics, a branch of mechanics that describes how objects move. Its goal is to predict the position of an object. How can we describe motion? We can describe it by using measures such as velocity and acceleration. Velocity, a vector quality, is displacement, a vector representing the shortest distance from the initial to the final position of a motion, over a certain time ($v = \frac{(x_2 - x_1)}{t}$). Acceleration, on the other hand, is a vector that represents the change in velocity over a certain period of time ($a = \frac{(v_2 - v_1)}{t}$). We can also measure the velocity and acceleration t a particular instant of time. These are called the instantaneous velocity and instantaneous acceleration. Instantaneous velocity is defined as the change in displacement over time as the limit of the change in time approaches zero. Instantaneous acceleration is defined as the change in velocity over time, as the change in time approaches zero. In class, we also learned that at constant velocity, displacement is proportional to time, and at constant acceleration, velocity is proportional to time.

The final topic we covered was free-fall. A free-falling object is any object that accelerates up or down under the influence of gravity. Free fall is represented by **g,** whose magnitude is equal to 9.8 m/s^2. Free-fall is just a model since it doesn't really exist on Earth. It could only exist if there were no air resistance, which Earth of course lack.

Here are the important equations we learned:

Average velocity:	$v = \frac{(x_2 - x_1)}{t}$	average acceleration:	$a = \frac{(v_2 - v_1)}{t}$
Instantaneous velocity:	$v = \lim \frac{x}{t} \ (t \to 0)$	Instantaneous acceleration:	$v = \lim \frac{a}{t} \ (t \to 0)$
At constant velocity:	$x \propto t$	At constant acceleration:	$v = v_o + at$
			$x = x_o + vt + \frac{1}{2}at^2$

Weekly Reports give students an opportunity to reflect on their new knowledge, ask questions about unclear ideas, and explore the value of question asking itself. By reading the report, an instructor may:

- Learn about students' conceptual difficulties and "misconceptions."
- Obtain useful feedback for reorganizing course content.
- Gain insight into how students' think about their own learning ("metacognitive processes").
- Explore students' understanding of knowledge and knowledge creation ("epistemology").

In addition to these applications in assessment, faculty have used weekly reports as a way to encourage students to reflect on their own knowledge, to organize their ideas in preparation for instruction, and to prepare for exams and review sessions. This can be accomplished best if students are asked to structure their responses to the first question, for example, to list separately the "knowledge" and "skills" they have learned. Knowledge may be assigned several categories: experimental evidence, (initial) observations, models (hypotheses), quantities and their units, laws, predictions, experiments that test predictions. Or you might choose stages of the "science learning cycle" (exploration, concept development, concept application). Thinking about these elements may help your students think about how they know what they know.

Example 2: Principles of Ecology

2. What remained unclear to you?

My confusion in this class mostly comes from not understanding words. When I was reading the text, some words were unclear even though they were defined: *phenotypic plasticity,* what exactly a *limiting factor* is, *synergistic,* and *relative humidity.* In the lecture, Prof. E spoke of *haploid* and *diploid.* Even though I know I should know what they are I don't. Many times in the packet readings I would get lost in the numbers. I wouldn't always know if the figures were good or bad, or if they were important or not. Lastly, one of the most confusing readings for me was "Exploitation of herbivore-induced plant odors by host-seeking parasitic wasps." It seemed like there was really no conclusion to it or even any kind of resolution.

3. What questions would you ask if you were the professor to determine whether your students understood this material?

a) What is the environment?
b) Give an example of an adaptation. Explain what you think causes it and how it helps the species.
c) What are the three conditions of natural selection?
d) What does William Sutherland's "Genes map the migratory route" tell us about the blackcap's navigational abilities? Include the navigational skills of the young.
e) What is the third environment?
f) What is habitat selection? Give an example.

Assessment Purposes

- To document students' understanding of their own learning
- To investigate how well students understand the content and logical relationships in the material they are learning;
- To document students questions and select the most typical ones;
- To give students feedback concerning the content and the level of difficulty of questions they consider important;
- To capture the development of students' reasoning and writing skills over time, and
- To provide a measure of students' emotional satisfaction with the course and their levels of frustration with its content

Limitations

When done well, Weekly Reports may provide a useful and easily accessible way of probing three aspects of students' knowledge:

- *Cognitive Aspects.* Responses to Question 1 offer insight into students' *conceptual understandings.* However, to be useful, students must provide a well-structured, in-depth exposition of the concepts, principles and theories they have studied, trying to explain how they learned what they think they did. A topical list of course content (e.g., "I learned about thermodynamics and enzymes.") does not provide the instructor with much valuable information.

- *Affective Aspects.* Responses to Question 2 may reveal some well-entrenched misconceptions, but ideally they also provide evidence of students' *feelings, attitudes and beliefs* about the content, the course and the instructor. As with Question 1, the most useful responses do more than list course content (e.g., "I didn't understand the difference between speed and velocity."); they provide the instructor with a glimpse of students' views and feelings about lectures, laboratories, recitations, textbooks, teaching assistants, and other aspects of the course.

- *Metacognitive Aspects.* Responses to all three questions provide information about students' *understanding of their own learning.* This kind of "self-reflective" and "self-monitoring" knowledge is essential to conceptual understanding in science, mathematics, and technological disciplines.

Perhaps the most significant limitation of Weekly Reports is that students need practice with the technique in order to provide much useful feedback to the instructor. However, normally this limitation can be overcome in a matter of a few weeks.

Example 3: Principles of Ecology

Student 16
2. What remained unclear to you?

I do not understand the process of natural selection and how it relates to the origin of species. I do not understand the theory of altruism and how it relates to natural selection. Things that may be unclear in lecture, often times, are clarified in recitation.

3. What questions would you ask if you were the professor to determine whether your students understood this material?

a) How does Gause's Law relate to the theory of natural selection and fitness?
b) How does environmental change X relate to species Z?
c) What is the consequence of arriving at a design affecting the environment without analyzing the organisms present in that environment?
d) Does the species ever affect the environment, or does the environment ever adapt due to its relationship to an organism?

Student 17
2. What remained unclear to you?

I don't quite understand what defines one ecosystem from another when so many factors are overlapping. I did not fully understand Professor E's reference to squirrels having visual adaptation and yellow lens light. He was speaking rapidly and I don't know if I heard all he said.

3. What questions would you ask if you were the professor to determine whether your students understood this material?

a) What are the three conditions that must be present for evolution by natural selection?
b) What is ecology?
c) What does an ecosystem consist of?
d) What do we mean by saying natural selection is survival of the fittest?
e) Why do birds who live on surface water catch fish?
f) Name three different types of orientations cues.

Student 18
2. What remained unclear to you?

The only questions I have are on the subject of water surface tension, density and the way water temperature and currents influence the oceans. I did not understand the example of the pond and fall and spring overturn and its relationship to water density. Prof. E was going very fast on this subject and the overhead he put up was difficult to read.

Teaching Goals

Student Learning Outcomes:

- Understands the difference between observational facts, concepts, principles and theories.
- Communicates in writing effectively
- Asks important questions
- Reflects on own knowledge and learning

Instructor Teaching Outcomes:

- Answers student questions on a regular basis
- Bridges gap between learning and assessment
- Communicates desire for student success
- Develops and refines instruction based on student feedback
- Receives regular feedback from students
- Tracks typical questions

Suggestions for Use

Use in Course Development

Weekly Reports highlight the most difficult moments for individual students and permit the instructor to see typical mistakes and conceptual difficulties. This insight enables an instructor to implement immediate changes in the course on a trial basis. Additionally, using Reports from several groups of students over extended periods of time, the instructor can identify moments that are difficult for all students and make relatively permanent changes in the course design. Questions students ask can be used for examinations and review sessions, and may assist the instructor in matching his/her expectations to those of the students.

Use as Teaching/Learning Tool

Weekly Reports provide a readily accessible way of introducing students to the nature of science as a powerful way of making sense of natural phenomena. They also give students practice in reflecting on their own knowledge and how they learn. If “epistemology” and “metacognition” (Novak and Gowin, 1984) are natural parts of a science course, students gain practice reflecting on significant issues, such as: “How do I know what I know?”; “How do other people know this?”; “Is this knowledge an observational fact or a mental construction devised to give an explanation for something I observe?” Questions such as these enable students to begin thinking about the nature of science and the nature of knowing.

Step-by-Step Instructions

- Include the requirement for Weekly Reports in the course syllabus.
- Decide how much “grade” weight you want to give them, but make sure it is not less than a regular homework assignment.
- You might substitute Reports for a portion of the homework assignments or weekly quizzes.
- Explain the reasons for the requirements. Give students a sample of a Report.
- Respond to atypical questions in the body of the Reports. Make a list of the typical questions and offer them for group discussion in class.
- Comment especially on question 3.

Variations

Report Structure

Depending on the course, the questions may be modified to reflect course or disciplinary requirements. For example, in a physics or chemistry course you might ask students to focus their questions on the homework problems. In biology, students might focus on lecture, laboratory or reading assignments.

One useful variation on Question 3 requires students to provide a rationale or justification for each of their questions [e.g., "If I were the professor I would ask students to explain the function of DNA…… *because understanding the function of this molecule is central to understanding all the physiological processes of living things*].

If you are using this technique in a science methods course (I found it very useful to teach science to pre-service teachers), you might change the last question to: "If I were the elementary teacher and taught this material to children, what questions would I ask to find out if they understood it?" This will offer an opportunity to teach question asking techniques.

Number of questions

In some courses, instructors feel that the third question is less informative than the first two, and they omit it. In other courses instructors assign the second and third questions every week, and the first one every other week to alternating groups of students. Both of these strategies reduce the workload of the instructor.

Frequency of Reports

Some instructors feel that it is too time-consuming to grade Reports every week. Instead they assign them every other week and have quizzes on alternating weeks.

Analysis

Scoring Weekly Reports

To start, we suggest that you decide how you are going to score the Reports. What is the maximum score? How is it to be distributed among the three questions? What criteria should be used to assign value to student responses? [You might take a look at the CAT on Scoring Rubrics by Diane Ebert-May]. Three issues are central to any scoring scheme for Weekly Reports*: What are the most important concepts of the week?; How much "explanatory value" is represented by each concept?;* and *How are the concepts connected to each other?*. A concept map may be helpful here but only if it is not overloaded with details, and really represents important connections. [See CAT on Concept Mapping by Michael Zeilik].

Level of Difficulty of Student Questions
To assess the understandings, interests and expectations of students, it may be useful to analyze the levels of difficulty posed by their questions. For example, one can assign four levels of difficulty to interrogatives posed in questions 2 and 3 as follows:

- Questions that ask for factual information can be assigned to the "*minimal level*" ("What is a physical pendulum?").
- Questions that ask for comparative information can be described as "*low level*" ("What is the difference between a simple pendulum and a physical pendulum?").
- Conceptual questions and questions about procedures done in previous class can be considered at a "*moderate level*" ("How can we prove that the period of a simple pendulum does not depend on its amplitude?").
- The "*highest level*" can be assigned to questions that required explanations not given in class before and that usually start with "Why?" ("Why is it that only a force that is linearly proportional to the displacement can provide a system with simple harmonic motion?").

Pros and Cons

- Weekly Reports help students reflect on their own knowledge and learning.
- Weekly Reports help students learn to express their thoughts coherently in writing.
- Weekly Reports help students learn to formulate good questions.
- Weekly Reports help students focus on the most important issues.
- Weekly Reports foster communication between professors and students.
- Weekly Reports provide continuous feedback for both sides.

However,

- Weekly Reports may be frustrating to students because they are rarely asked to write in science courses or to reflect on their knowledge.
- Weekly Reports require training of students.
- Weekly reports take a great deal of instructor time (answering questions).
- Reliable scoring requires knowledge of rubrics.

Theory and Research

The use of Weekly Reports in college SMET teaching and assessment emerges from a "constructivist" philosophy of science education. In its most basic form, Human Constructivists (Mintzes, Wandersee and Novak, Eds., 1998) reject the view that knowledge is a product that can be faithfully conveyed by instructors. Instead they substitute the idea that knowledge is an idiosyncratic, dynamic construction of human beings, and that instructors are "middlemen" or negotiators of meaning. Taken to an extreme, this philosophy suggests:

> You cannot teach anybody anything. All you can do as a teacher is to make it easier for your students to learn. (Redish, 1994, p. 798)

What are the implications of this view for college SMET instructors? Perhaps the most important implication is that without knowing what students are thinking, an instructor can offer only limited assistance in helping them learn. Put slightly differently, "….the most important single factor influencing learning is what the learner already knows. Ascertain this and teach him [sic] accordingly" (Ausubel, Novak and Hanesian, 1978). That is why metacognition is crucial for implementing a constructivist approach to teaching and assessment.

Metacognition refers to knowledge, awareness, and control of one's own learning (Baird, 1990; p.184). Gunstone and Mitchell (1998) suggest examples of learning behaviors which illustrate metacognition in classrooms:

> Examples include telling the teacher what students don't understand, planning a general strategy before starting a task, seeking links with other activities or topics, and justifying opinions. (p. 137)

Certainly, one cannot subscribe to a constructivist philosophy in teaching and a traditional approach to assessment. If we want our students to construct their own understanding, reflect on their knowledge, ask questions and plan their own learning, we need to devise assessment methods that assess these aspects of learning.

Journal writing is one of the least used forms of alternative assessment (Lester, et al, 1997). This may be due, at least in part, to the time consuming qualities of writing and assessing this writing. However, Bagle and Gallenberger (1992) suggest that,

> Writing is more than just a mean of expressing what we think – a means of shaping, clarifying and discovering our ideas (p. 660).

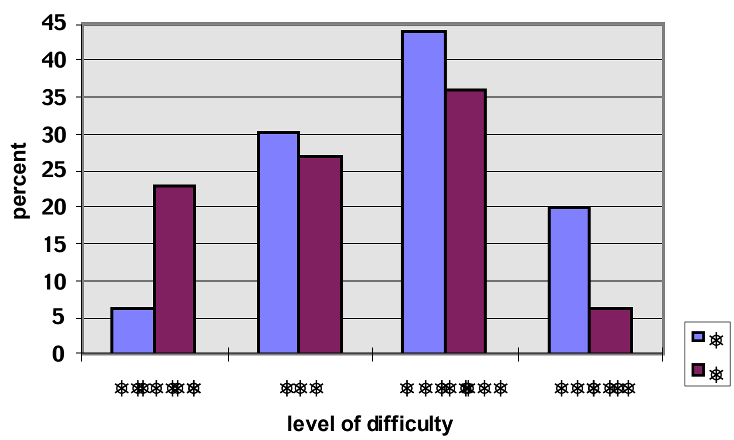
Weekly Reports are not just journals – they are structured journals, and have other purposes. In the beginning, students usually express negative feelings towards them, but very soon they start appreciating the help that Reports provide. Here we cite some comments of our own students:

- "Weekly Reports helped me to learn in this course. Sometimes I write that is said in class rather quickly. Writing it again gave me more of a chance to understand/learn it. It is better that I had to review, because I understand/remember more. Don't get me wrong: I hated doing them at the time because they took forever! But I am glad we had to now!"
- "Although the Weekly Reports seemed to be a burden throughout the semester, I can conclude that they greatly helped me to learn. I was forced to evaluate how much and just how I learned what I learned and correct misconceptions I had. Also it forced me to pay excellent attention in class because I knew I would eventually do a report in it".
- "Sometimes I would leave class being so filled with information that my Weekly Reports were my only way of organizing my knowledge".
- "They allowed me to organize my weekly learning and ask any questions about misunderstandings. They will also act as clear, concise notes for future reference".
- "Sometimes at the end of the class I thought I understood everything but when I wrote my Report I would find what I did not understand".
- "I like the fact that we could pose questions that remained unclear, and you actually answered all of them. I also liked that we could predict your questions".
- "The Weekly Reports did help because although they were time consuming, they actually forced me to grapple the ideas that we were presented in class. The structure we were asked to put them in also helped me to think about the concepts in a more logical way".
- "The Reports made me stop and check if there was something I did not understand".

- “Even though I hated the Weekly Reports because they were time consuming they were a great learning tool for me. It forced me to sit down and digest what we learned. It also made me think about how to put it all into clear thoughts that made sense. This was a perfect assessment and it definitely reinforced what we had learned”.
- “They helped me to organize the information in a meaningful manner. Instead of having information scattered all over, that is not related to each other, I had the information easy to access and understand”.

Our own research (Etkina, 199-) supports the value of using Weekly Reports. For example, if you graph the number of student questions at each level as a percent of the total for both parts of the Weekly Reports (Fig. 1), the majority of the student questions for both parts of the Reports fall in the “low” and “moderate" categories. Generally, students tend to ask questions that help them clarify and apply previously taught concepts. This means that they tend to assign the same value to the content as the professor. Research in two courses (i.e., “Introductory Physics” and “Electrodynamics”), demonstrated that the number of “minimal” level questions is much higher for part three while the number of “highest” level questions was considerably higher for part 2 of the reports for the introductory course and vice versa for high level electrodynamics. In other words the students either expect the professor to ask them much easier questions than they wanted to ask for themselves (introductory physics course data) or vice versa (electromagnetism course data). These mismatches do not help to raise the level of confidence in our students.

Fig. 1



A - the number of questions that the students asked in the second part of the Reports, assigned to four levels of difficulty and expressed as a percent of the total number of questions asked in this part.
B - the number of questions that the students asked in the third part of the Reports, assigned to four levels of difficulty and expressed as a percent of the total number of questions asked in this part.

Links

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Eugenia's Story

I was born in Moscow, Soviet Union.

As long as I remember myself, I wanted to be a teacher. Maybe because this was the only profession I was familiar with – my mother was a math teacher, my father – a physics professor, my grandmother – a biology teacher. But there was another reason for this. I did not like school. I was a very unhappy student, and I could see what the teachers were doing wrong to make me feel that way. So I thought, when I become a teacher, I would be different, and my students would be happy. As I was growing, ideas of what to do differently were shaping up and by the time I graduated from the Physics Department of Moscow State Pedagogical University, I knew very well what kind of teacher I would like to be. The rest of my life was putting this image to work.

The ideas of human constructivism were unknown in the Soviet Union at that time, but these were the ideas that I came up with on my own and wanted to put into practice of physics and astronomy teaching. I wanted my students to understand why they were learning what they were learning, what are epistemological connections between different pieces of physics they learned every day, and how to learn them best. I conducted clinical interviews with the students (I did not know that they were called that way but this is what I did) to learn they way they were thinking and developed Socratic questions to lead them through the physics course. I developed materials for astronomy courses that provided students with observational data and called for explanations and predictions. I taught them to draw concept maps and visualize problems. There was no theory leading me through this work, so I just tried what made sense to me and measure gains of my students on different tests.

After my family moved to New Jersey I was invited to teach in the Physics Department, at Rutgers University. I spent two years developing, teaching, and coordinating the introductory physics course for students at-risk – women and minorities. It was an unforgettable experience. I started reading books written by Joseph Novak and Joel Mintzes, research papers in physics education, and tested these ideas in our course. Research that we did demonstrated that the methods were very successful, our at-risk students outperformed students from the traditional course being originally much weaker.

Later I was offered a job in the Graduate School of Education. I thought that being a science professor I could move towards my goal (making learning a happy experience) much faster by educating future teachers. I also discovered another area where I could make a difference – helping prospective and inservice elementary teachers learn science. This work reinforced my constructivist approach to teaching, shaped up the methods and also posed new questions that I am searching the answers for.

I am trying to help people to learn how to teach physics at different levels: elementary, high school, undergraduate in a way when children/students learn, not only teachers teach. I hope that my students at all levels will apply this philosophy in their teaching too.