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Using Reflection Documents to Assess Student Learning

Larkin A. Powell*

ABSTRACT Traditional assessment methods such as tests and essays may not be adequate to evaluate students' ability to solve problems and think critically. I developed a qualitative assessment technique for a junior-level Wildlife Management Techniques course that incorporated written responses in a pre- and post-course reflection exercise. I provided the students with three reflection documents: (1) an historic photograph of Nebraska waterfowl hunters, (2) a short reading from Aldo Leopold's *Sand County Almanac*, and (3) a memo on wetland habitat management from a state wildlife agency. I evaluated students' pre- and post-course responses to a series of questions about these documents. The pre-course assessment was designed to allow me to determine what knowledge and skills students brought to course; the comparison of the pre- and post-course responses allowed me to determine whether their knowledge had increased during the course. When asked to explain what they knew about the documents, 88 to 96% of the students showed more in-depth understanding or enhanced critical thinking in their responses after taking the course. When asked what they found most interesting about the documents, 40 to 68% of the students increased in their use of proper terminology or other indicators of improved understanding. This assessment tool is flexible and directed at the student learning objectives for the course. As such, it may serve as a good complement to standard student evaluation forms.

Active learning methods are used increasingly by natural resources faculty (Ryan and Campa, 2000; Millenbah and Millsbaugh, 2003), because it may be advantageous for learning. Active learning includes fewer 1-hour lectures and more research experiments, group discussions, role-playing, or team problem solving (Ryan and Campa, 2000). However, the adaptation of a course to active learning methods may require new assessment tools. Exams, term papers, homework assignments, presentations, group projects, and other assessment tools are used to provide a quantitative assessment of students (Angelo and Cross, 1993). In a course employing active learning, these traditional means of quantitative assessment may help to evaluate a student's progress toward completing some learning objectives, but may not adequately evaluate a student's ability to think critically or solve problems (Angelo and Cross, 1993; Ryan and Campa, 2000). How can we assess our ability, as instructors, to provide learning experiences that improve critical thinking or problem-solving skills?

Assessment can happen at two levels at the conclusion of an educational activity. First, instructors must determine if students met the course's learning objectives. Did students increase their knowledge base and skill level because of the learning experiences provided during the course? Second, instructors must also self-assess their attempt to provide opportunities for students to become more effective learners (Angelo and Cross, 1993; Bass, 1999). Which learning experiences worked, and which need to be

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Impact Statement

A portrait instructor used before-course and after-course self-portraits of students to assess the impact of a course on her students' abilities. Most instructors teach subjects in which student learning and progress is not quite as obvious. But, all instructors need easy-to-use methods to assess student improvement in critical thinking and problem solving. I modified the before/after approach to include student reflections on 3 documents. At the end of the course students were able to assess their own progress, and I used the assessment to improve the course.

improved?

Traditional, summative assessment methods, such as exams and quizzes, result in percentage scores that provide evidence for quantitatively evaluating or grading students. In contrast, formative assessment methods provide a qualitative assessment and are usually designed to help the instructor improve the quality of student learning experiences (Angelo and Cross, 1993). As such, formative assessment tools are usually not graded, and could potentially be anonymous.

Formative assessment techniques may include email journals or short, end-of-day evaluations for instructors throughout the semester (Steward et al., 2004). These methods might increase student learning (Black and Wiliam, 1998); but these tools are designed primarily to provide early feedback to the instructor in cases where students might be missing course concepts or content. I distinguish these instructor-based, formative assessments from learner-based, formative assessments that are designed to assess a student's ability to think critically and integrate course information into their life (Ryan and Campa, 2000). Learner-based assessment tools have the

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Table 1. Learning objectives for junior-level Wildlife Management Techniques course at the University of Nebraska-Lincoln during fall 2003. The assessment tool described in the text was designed to assess objectives 4, 6, and 9.

1. Demonstrate the ability to apply concepts of experimental design and scientific method to solve management problems.
2. Solve management problems for abundant and threatened/ endangered species using field and parameter estimation techniques for population analysis (animal capture/ marking, surveys, and aging and sexing).
3. Use traditional and adaptive techniques for population estimation and population analysis to manage abundant and threatened/ endangered species.
4. Set defensible harvest regulations, and determine if harvest is sustainable for a population.
5. Determine appropriate uses of laboratory techniques for forensic analyses related to management and conservation.
6. Use animal movement data and quantitative methods to determine habitat preference.
7. Demonstrate basic fluency with Global Positioning Systems (GPS) and Geographical Information Systems (GIS) technology, in the context of solving management problems.
8. Incorporate habitat evaluation methods and vegetative sampling methods into analyses of grassland, wetland, forest, and agricultural habitats.
9. Develop a defensible habitat management plan.

potential to provide feedback to both instructor and student on the effectiveness of learning experiences (Millenbah and Millsbaugh, 2003).

Fritz (2003) conducted a learner-based formative assessment for a Perceptual Drawing course by having each



Fig. 1. Photo of waterfowl hunters in 1930 from Nebraska's Niobrara River Valley. Photo provided by Larry Schaffer, published in July 2003 NEBRASKAland magazine. Used with permission of the owner, Lois (Cole) Schaffer. Lois is the sister of Zane Cole, the young man in the center of the photo. Her father, Guy Cole, is at the right; Guy's brother-in-law, Pat McGinnis, is at left.

student draw self-portraits during the first and last weeks of her course. Most first-week self-portraits were "mug shot" line drawings. By the last week of the course, students had learned how to incorporate composition, lighting, transition of values, and shading; these drawings were much more realistic and proportional. This assessment tool was powerful; the result of the learning experiences in Fritz's course was obvious by comparing the two portraits (Fritz, 2003). Unfortunately, it may not be possible to document student learning in wildlife educational activities with such efficiency.

With Fritz's assessment tool in mind, I designed a formative, qualitative assessment tool for a junior-level Wildlife Management Techniques course. If properly guided (Angelo and Cross, 1993; Moore, 1993), student writing, much like portrait drawings, can provide the basis for a qualitative assessment of learning. My goal was to determine if the use of reflection documents could be used to determine if students are meeting learning objectives for my course (Table 1). I used this exercise to assess three of my nine learning objectives.

Methods

Reflection Documents

Bass (1999) encouraged the use of "artifacts" to evaluate student learning through the use of pre-course and post-course evaluations. Here, I introduce the term *reflection documents*, rather than *artifacts*. To assess major learning experiences in my Wildlife Management Techniques course, I selected three reflection documents. Each document was simple and could be quickly processed by the students; I expected the course to improve the students' understanding of each document. I selected documents with connections to local management issues to increase student interest in the documents. The students evaluated the documents and responded to questions that I used to gauge their ability to interpret and understand the documents.

First, I used a historic photograph of waterfowl hunters in Nebraska's Niobrara River valley during the 1930s (Fig. 1) to assess the learning objective of "Set defensible harvest regulations, and determine if harvest is sustainable for a population" (Table 1). The photo shows hunters with a daily bag that is much larger than current regulations allow; their success is also greater than most present-day hunters could hope to achieve. Pre-course consideration of the photo might stimulate a student to identify the connections between family members in the photo, the year (based on the identity of the automobile), the type of shotgun used, and the species of waterfowl. A student with more experience in waterfowl management would be expected to reflect on changes in regulations and population sizes during the past century, or the student might comment on the potential effects of a large harvest on population size.

Second, I selected the *Home Range* passage from (Leopold, 1949, p. 78–81) to assess the learning objective of "Use animal movement data and quantitative methods to determine habitat preference" (Table 1). The passage

contains Leopold's descriptions of movements of birds and mammals in the winter, along with musings about the size of animals' home range. It begins:

The wild things that live on my farm are reluctant to tell me, in so many words, how much of my township is included within their daily or nightly beat. I am curious about this, for it gives me the ratio between the size of their universe and the size of mine...

A student with little experience in home range analysis might simply comment that Leopold had many animals around his property. After experiencing the course, I would expect a student to comment on the assumptions that Leopold constructs as he makes his crude home range calculations or the sample size of observations used to create the calculations. An especially observant student might comment that Leopold descriptively used a home range estimator that resembled a minimum convex polygon.

Last, I selected an inter-agency memo from the Nebraska Game and Parks Commission that describes management plans for a saline wetland near Lincoln, NE. This document was chosen to assess the learning objective of "Develop a defensible habitat management plan" (Table 1). Because of the technical nature of this memo, students with no exposure to management plans would be expected to literally regurgitate information from the memo. After writing a management plan, the students could be expected to identify strengths or weaknesses of the plans suggested in the memo.

Assessment Criteria

I offered the three reflection documents to my students on the first day of the fall semester 2003. I modified the list of assessment questions suggested by Bass (1999, Table 2), and the students were given 30 minutes to complete the exercise. After writing their responses, I asked student to share their answers, first with a small group of four to five students; then, they were asked to summarize their responses for the rest of their classmates. This process

provided a record of their responses, but also provided an opportunity to compare their responses with their classmates. On the last day of the course, the students were given the same documents and the same questions. After completing the exercise, students were asked to compare their responses with their pre-course reflections. The comparison gave them an opportunity to evaluate their own progress during the course.

To compare a student's pre-course and post-course responses, I developed a rubric (Table 2) to determine if their post-course response showed an improvement over the pre-course response. I used a rubric to reduce the subjectivity of my evaluations. I considered my a priori expectations, identified above, as I created the rubric. In general, improvement could be documented by evidence of critical thinking, evidence of problem-solving, the correct use of jargon, or evidence of a more in-depth understanding of the document (Table 2). I looked for evidence of critical thinking by searching for a student's own position or hypothesis, integration of other ideas, or identification of implications to larger issues (Brown and Rumph, 2006). I looked for evidence of problem-solving abilities by searching for identification of processes used by professionals to approach problems, or constraints to understanding an issue (Schreyer Institute for Teaching Excellence, 2007). I matched student's pre- and post-assessment responses using their names on a cover sheet, but evaluated their responses anonymously after the cover sheet was removed.

The goal of this assessment exercise was to evaluate learning experiences using formative or qualitative indicators. However, the rubric (Table 2) allowed the transformation of qualitative data to quantitative data. To quantitatively compare improvement among questions and among learning objectives, I calculated the proportion of the responses that I judged to improve. I constructed 95% confidence intervals (CI) for the binomial proportions to determine critical differences as suggested by Williams et al. (2002, p. 50).

Table 2. Assessment questions (modified from Bass, 1999) used with each reflection document, and the rubric used to determine if the students had improved after participating in the Wildlife Management Techniques course at the University of Nebraska.

Assessment questions	Indicators of improvement
1. What do you find most interesting about this document?	A. Use of proper jargon should increase (e.g., "harvest regulation," "Type II wetland," "North American Waterfowl Management Plan") B. Comments should reflect information gained in class
2. What experiences do you have in your background that can help you make sense of this document?	A. Should show more in-depth understanding B. Should show enhanced critical thinking (student provides own position or hypothesis, integrates other ideas, or identifies implications to larger issues) C. Should provide specific examples of course experiences that add to previous life experiences
3. What kind of information can be learned from this document?	A. Should interpret more information from document B. Should show enhanced critical thinking (see above) C. Should show enhanced problem solving skills (student identifies processes used by professionals to approach problems or constraints to understanding an issue)

Results

Twenty-five of the 33 students completed both the pre- and post-course assessment. During the pre-course assessment, students described several previous learning experiences that helped them make sense of the reflection documents. The students listed such courses as Ecology, Wildlife Ecology and Management (the prerequisite for my course), Range Plant Identification, Introduction to GIS, Natural Resources Policy, and Wetlands. Students also referred to prior projects in other courses, such as a Sandhill crane (*Grus canadensis*) harvest management project, and a critique of a wetland management plan. One student had conducted a summer research project in which she used telemetry to estimate mesopredator home ranges. Students referred to hunting experience, knowledge of the outdoors, or a farm/rural upbringing as valuable learning experiences. Three students felt that previous internships or temporary jobs had helped them interpret the documents.

As they completed the post-course evaluation, students considered the waterfowl hunting photograph. Students reflected on learning experiences that occurred during the semester as they attempted to solve the harvest management case problem. Valued experiences ranged from a general, "I learned about harvest management," to a more specific, "The prairie chicken problem case gave me a better understanding of setting harvest regulations." One student mentioned the value of learning historical trends in waterfowl management. Another wrote that they felt it was useful to discuss additive and compensatory harvest models. Similar reflections were offered as they considered the reflection documents for the other two learning objectives. While reflecting on the Leopold passage, a student reflected, "I learned the difference between initial observation and scientific data analysis." This student had experienced the task of using radio telemetry data and home range estimators to describe animal movements during the course. Students found that the course exercise of quantifying wetland habitat and developing a management plan for a local saline wetland had given them insights into the reflection document that described agency plans for wetland management. One student wrote that it was valuable to, "go to Arbor Lake, do the sampling, and try to make a management decision." Another student noted that he had learned that, "management is a never-ending process."

Students showed more improvement on the, "What do you know about this document..." question in the comparison of students' pre-course assessment to their post-course assessment writing (Table 3). Ninety-six percent of students showed improvement on the wetland habitat issues, and 88% of the students' responses improved when asked what they knew about the waterfowl hunting photo after experiencing the course. An example of my evaluation of one student's reflections on the waterfowl hunting photo is shown in Table 4. The, "What do you see here?" question showed the lowest levels of improvement; only 40% of student responses showed improvement when asked what they saw in the waterfowl photo (Table 3).

Discussion

Reflection Documents

The field of natural resources (including my field of wildlife ecology and management) is ripe with potential reflection documents; potential documents include graphs of empirical data, maps, photos, theoretical model diagrams, inter-agency memos, and historical writings. However, instructors must choose documents carefully to promote their effectiveness as an assessment tool. I suggest that documents should be chosen so that:

1. The document relates directly to a course learning objective.
2. Student processing of the document may result in several levels of understanding (e.g., "This is a soil map," vs., "This soil map has an error.")
3. Student understanding of the document should be expected to improve after involvement in the course's learning experiences.
4. Students should be able to mentally process the document relatively quickly during the assessment exercise.

Natural resource professionals in nonteaching roles can be an excellent resource for reflection documents. For example, the daily activities of most state or federal agency wildlife biologists exemplify the "real world" that active learning seeks to simulate (Ryan and Campa, 2000). Thus, it is critical for teaching faculty and nonteaching biologists to establish relationships that can result in quick transmittal of new active learning activities to the classroom. These relationships depend on the willingness of (1) teaching faculty to make contact with appropriate biologists, and (2) agency biologists to share research products, memos, data, and other documents with teaching faculty. In my course, the Nebraska Game and Parks Commission's (NGPC) wetland biologist provided the memo used as a reflection document, and the biologist gave a guest lecture on wetland management. The NGPC also provided the waterfowl photo, which was published in their publication, *NEBRASKA-land* magazine. Student contact with these biologists have resulted in professional development opportunities that are critical for wildlife students (Moen et al., 2000), which underscores the value of nonteaching biologists to wildlife undergraduate education.

It should also be clear that this assessment technique could be used in courses, as well as out-of-classroom educational experiences. In my field of wildlife ecology, for example, the waterfowl photo (Fig. 1) could be effectively used before initiating a hunter education activity. Many natural resources professionals are engaged in outreach, such as University Extension programming; assessment is a standard process in outreach programs. This technique can provide unique information that cannot be conveyed by traditional "agree/disagree" forms. For my semester-long course, I selected three reflection documents. For shorter activities, such as hunter education, one well-chosen document would be effective.

Use of Pre-Course Assessment

The pre-course assessment exercise that I describe has

Table 3. Proportion (95% confidence interval) of 25 students showing qualitative improvement on responses to 3 questions from a pre-course to a post-course assessment (Table 2) during Fall 2003. Three reflection documents were provided to the students: (1) a historic photograph of Nebraska waterfowl hunters from 1930, (2) a reading from Aldo Leopold's Sand County Almanac, and (3) a wetland habitat management memo from Nebraska's state wildlife agency.

Question	Reflection document		
	Waterfowl photo	Leopold reading	Wetland management plan
What do you see here?	0.40 (0.19)	0.56 (0.19)	0.68 (0.18)
What do you know about this document based on previous knowledge?	0.88 (0.13)	0.84 (0.14)	0.96 (0.08)
What kinds of information can be learned from this document?	0.60 (0.19)	0.72 (0.18)	0.80 (0.16)
Average	0.63	0.71	0.81

Table 4. Evaluation of one student's response to the reflection document shown in Figure 1 (waterfowl photo). The student's responses at the beginning and end of the course are shown, along with the evaluation of the responses using the rubric in Table 2.

Question	Pre-course assessment response	Post-course assessment response	Evaluation
What do you see here?	"Three generations in one family went hunting. The grandfather and the father were the ones to shoot the birds."	"The picture shows a family of hunters from the 1930s. These men have just harvested a large number of ducks. It seems that they did not have a bag limit as we do today."	Improvement: The use of jargon ("bag limit") increased. Comments reflect information learned in class.
What do you know about this document based on previous knowledge?	"It seems as though the grandfather taught the father how to hunt and now the father is teaching his son."	"These men have harvested more than legal limits of today. At this time, they were probably still using lead shot which is also now illegal."	Improvement: The discussion of legal limits and methods of harvest shows more in-depth understanding at end of course, and reflects course experiences. Student's hypothesis about lead shot use and connection to larger issue (lead poisoning) is evidence of critical thinking.
What kinds of information can be learned from this document?	"This shows a lot about the way life used to be, and how much has changed since then (way of life, hunting limits)."	"We can see how hunting was done in the 1930s and compare to how different things are today."	No improvement: The post-course response does not show increased ability to interpret more information from document. The response does not provide evidence of critical thinking or problem solving skills.

merit as a stand-alone activity for the student, the class, and for the instructor. For the student, the exercise provides an opportunity for written expression on the first day of the course. My students were able to determine that they would be addressing issues surrounding harvest management, animal movement, and wetland management during the course. They were also able to self-identify areas that they had significant prior knowledge, or vice versa.

For the class, the critical stage in the pre-course assessment exercise was the sharing of information in small groups, and later in verbal group summaries to the entire class. Students were able to identify class members who could serve as critical resources. For example, approximately 25% of my students had critiqued a wetland management plan in a Natural Resources Policy course in the previous semester.

From my standpoint, as an instructor, the pre-course assessment provided a wealth of information about where students were at in their learning process. I was able to use the assessment to form groups for collaborative exercises. The previous learning experiences of students—such as work experiences, extensive hunting experience, internship experiences, and previous course experiences—helped me identify students that could be asked to take leadership roles in groups or add real-world information during my mini-lectures. For example, I asked one student to provide a video of his undergraduate research experience that involved trapping and radio-marking deer.

Use of Post-Course Assessment

This assessment tool was directed toward the specific learning objectives for my course (Table 1). Thus, I considered the assessment exercise to be more relevant than

standard course-instructor evaluation questionnaires (the College of Agriculture Sciences and Natural Resources at University of Nebraska-Lincoln uses Course/Instructor Evaluation Questionnaire [CIEQ], Comprehensive Data Evaluation Services, Tucson, AZ).

I modified Bass' (1999) questions to fit my course; I also limited my assessment to three questions per document, as my goal was to address multiple course objectives with three reflection documents in a 30- to 45-minute time period. Bass (1999) used six assessment questions per document; some teachers may wish to use more questions, and allow more time for reflection.

The post-course assessment was valuable as I tried to assess the value of course learning experiences. For example, the pre-assessment showed that few students were familiar with wetland habitat analysis and management plans. As such, the class showed much improvement on these issues (Table 3). For example, 68% were able to describe the document better after taking the course, and 96% were better able to describe what they knew about the document after the course. Thus, I believe my habitat management problem case was designed well for the students in the course. Alternatively, many students had a hunting background, and seemed familiar with issues surrounding waterfowl harvest and setting regulations. On the pre-course assessment, many students were able to adequately describe the photo (only 40% improved after the course). But 88% improved when asked what they knew about the document after the course. Student background will vary with each group of students in future semesters; annual sampling during the pre-course assessment should allow me to determine if I can skip some of the introductory materials about harvest management and concentrate on the quantitative aspects of modeling effects of harvest on populations.

I emphasize that my assessment results from fall 2003 (Table 3) are not to be interpreted as experimental results. As noted, a primary goal of this assessment tool is to respond with instructional flexibility to student needs in a given semester. I have used this tool with similar documents each year since 2003, and the assessment information has given me the information I need to make course decisions. I have slowly reduced the amount of introductory material on harvest management. Similarly, instructors in formal courses or other education activities may find themselves teaching novices during one session and experts in another session. Extension educators also face varied audiences during repeated programs.

Last, the post-course assessment provided the students with an opportunity to quantify their own learning. By providing the students with a copy of their pre-course assessment, they could see a benchmark of where they started the course. I believe this benefit of the exercise, alone, was worth the time it took to complete the assessment writing. All students, regardless of their performance on exams, should have seen a noticeable difference in their knowledge and understanding. This was a positive benefit of the exercise for my students—most were pleasantly surprised at their progress during the semester. Without such opportunities to view their pre-course selves, most students may be

unaware of how much they learned in a given course. The consistent use of an evaluation like this throughout courses in a university program could improve student retention rates if students are constantly shown progress toward becoming a skilled professional. Similar self-comparisons could be meaningful to participants in extension or other outreach programs.

Future Plans

I plan to change the reflection documents to emphasize other course objectives. For example, I plan to present students with a figure from a published habitat suitability index model for greater prairie-chicken (*Tympanuchus cupido*; Prose, 1985) to assess the learning objective, "Incorporate habitat evaluation methods and vegetative sampling methods into analyses of grassland, wetland, forest, and agricultural habitats" (Table 1). I could also assess the learning objective, "Solve management problems for abundant and threatened/endangered species using field and parameter estimation techniques for population analysis (animal capture/marketing, surveys, and aging and sexing)" (Table 1) by presenting the students with a jaw from a 1.5 year-old white-tailed deer (*Odocoileus virginianus*) or a wing from a juvenile sharp-tailed grouse (*Tympanuchus phasianellus*). Each of these documents would meet the criteria for effective reflection documents above.

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