Learning through peer assessment

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Ecological succession is driven by disturbance, both natural and human-induced, and change occurs at multiple scales, both temporal and spatial. Understanding the mechanisms involved in succession requires the integration of many ideas, some of which may contradict students' belief that succession is only a unidirectional and linear model. The notion of ecosystems as static, or as eventually reaching a final state of equilibrium, needs to be critically challenged by students; ecosystems are stochastic, and this dynamism is the only constant (White and Pickett 1985, Kozlowski 2002). Gurnell *et al.* (pp 377–82) present a novel succession model that provides a context for students to analyze, synthesize, and integrate basic ecological concepts across scales and between groups of organisms.

In previous Pathways articles, we described cooperative learning strategies that are based on the growing body of research showing the cognitive, motivational, affective, and social benefits of college students working in small groups (Bruffee 1999). Here we introduce formative peer assessment strategies to determine the effectiveness of cooperative learning experiences. A major concern of faculty and students about cooperative learning is accountability. In theory, teams are formed to accomplish a common goal and necessarily involve both positive interdependence, where all members must cooperate to complete the task, and individual and group accountability for the work (Smith *et al.* 2005). Peer assessment enables students to measure the effectiveness of group work, to fully understand the purpose of the instruction and assessment criteria, to monitor learning, and to improve their ability to transfer what they have learned to new situations. Formative peer assessment and feedback is more helpful in improving student learning than summative assessment that generally measures specific outcomes (Sheppard 2004).

Student goals

- Identify biological and physical components of a dynamic river system.
- Build a model that integrates the components of a river system, showing the response following disturbance.
- Demonstrate understanding that ecological systems are complex, and that there may be more than one correct model for any given system.
- Use peer assessment to learn from and provide substantive feedback to peers.

Instructor goals

- Use conceptual model building as a tool for facilitating and assessing students' understanding of succession.
- Facilitate students' understanding of and ability to practice peer assessment.

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Preceding class

Succession is often included as a topic within a unit on ecosystems. Introduce the concepts of disturbance and succession by engaging students with a series of time-lapse sequenced pictures of succession, including classic linear sequences (eg old field succession) and a set showing disturbance (eg Yellowstone fire or a local example). By working through these examples, students are prepared to make predictions about succession from the Gurnell paper. Models are simplified approximations that provide useful starting points for studying complex natural processes.

Homework

Using information from the Gurnell paper, identify the biological and physical components of this river system. Create a visual model (eg a box model with arrows) that illustrates how the habitats and organisms change in a particular sequence over time. Include in the model the disturbance that is driving this system. As you construct the model, think about what is happening and why. Each individual brings to class one copy of her/his model (use carbonless paper, powerpoint, or CTOOLS [www.ctools.msu.edu]) for each group member.

Next class meeting

Peer assessment of models

During class, students use the rubric in Panel 1 to provide constructive comments about each other's models. Then together, they use their models to derive and draw the most complete and explicit model of the river system. The teams use their revised model to develop a response to the following questions and turn in one answer set per group, to be scored as a group assignment. Figure 1 is an example of a model showing how floods can influence habitats, organisms, and processes across scales and groups.

Assessment (group)

1. How does the biomass in the model change over time? Why?
2. Which species appear and disappear over time? What species traits are unique to the (a) wood jam stage and (b) established island stage?
3. Predict the diversity of species in both the wood jam and established island stages. Describe possible interactions among species.
4. Using your group's model, predict what will happen to the established island stage when there is another small

Panel 1: Rubric for assessing disturbance models

Event	– accurately identified (1 point)
Habitats	– created by disturbance (1 point)
Organisms	– impacted by disturbance event (or resulting from creation of habitat) (1 point)
Processes	– logical progression of response to events – includes early (wood jam), mid (pioneer), and late (established islands) stages (3 points)

flood and another large flood. Limit the response to three sentences for each scenario.

5. In general, what components of succession are stochastic, and what components are static?

After the groups turn in their work, the instructor selects two or three different models to display and discuss. If the classroom is not equipped with a document camera, the instructor can select two or three groups to draw their model on a transparency while the groups are working. By comparing models, the students should infer that there are multiple rather than single pathways for succession within a system.

Peer assessment of cooperative work skills

Since this activity will take an entire class meeting, it is critical that students spend time productively. Peer assessment (Panel 2) provides feedback to the instructor about the effectiveness of groups in this activity (Liu *et al.* 2002), and about students' ability to apply complex concepts related to succession. It can also be used as a regular learning and assessment tool during a course.

Students receive the assessment criteria before they begin the activity. Each group member evaluates all other team members' contribution by applying a point distribution system for both quantity and quality. The quantity scale should add up to 100% (eg, 25% equal share in a 4-person group) for the teamwork assessment (criteria 1) and quality for each individual contribution (criteria 1–5) is based on a point system from 4 to 0 (highest to none). Each item in Panel 2 is derived from criteria used in engineering and science for assessing collaborative work (Sheppard 2004). Other criteria can be added, depending on the goals of the cooperative groups.

Analysis

The assessments are collected, averaged, and combined with the instructor's score of the group model and questions. As with any assignment, the weighting of each component of this activity is determined a priori and is linked to the goals of the course.

Panel 2. Assessment of cooperative work skills

Criteria		*S 1*	*S 2*	*S 3*	*S 4*
1. Teamwork, did an equal share of the work, % estimate	Quantitative				
	Qualitative				
2. Kept an open mind, considered other's ideas	Qualitative				
3. Contributed useful ideas	Qualitative				
4. Model prepared prior to class (in this case, homework)	Qualitative				
5. Communicated ideas clearly/ effectively	Qualitative				

S = Student

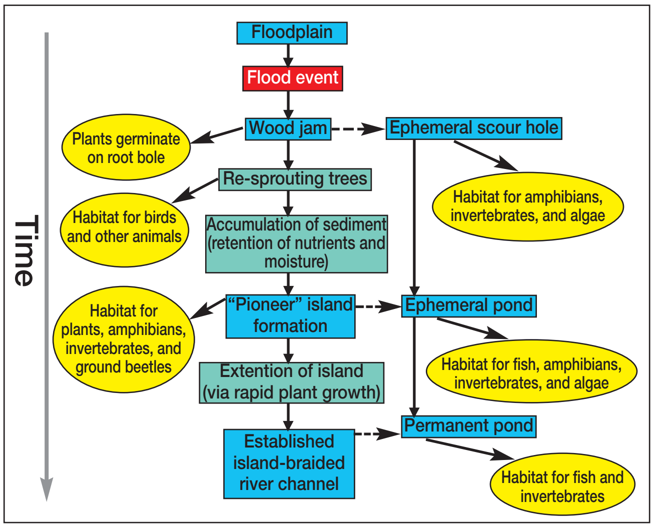

***Figure 1.** Model showing how floods influence the components of a river.*

Final note

Collaborative work enables students to deepen their understanding of ecological succession by developing and applying a model of a river system. The two types of peer assessment modeled are intended to drive both cognitive and behavioral attributes of learning, as students challenge each other about what they think they know. A comparison between the groups' models and associated written assessments provides evidence about students' ability to use models to understand concepts.

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