Team-Based Learning in: "MOTOR LEARNING AND CONTROL"

1. Course Situation

- Department: Kinesiology
- Subject: Motor Learning and Control (KIN 2332); required course for majors
- Level: Lower Division course
- Students: N = 48-58; Kinesiology majors, majority male, age ranges from 18 to about 40 years.
- Time Structure: two 80-minute class sessions per week; 15 weeks
- Any special course or classroom factors: None

2. Learning Goals for the Course

I. Basic "Understand and Remember" Learning Goals:

   a. Understand theoretical foundations of motor learning and control

   b. Understand the principles of providing effective instruction for learners with varied needs and skill levels

II. Application Learning Goals: Students will be able to apply principles and methods of motor learning to teaching situations

   a. Apply theories of motor learning and control to real life examples of motor skills
   b. Identify and apply different measures to document that a student is actually learning a motor skill
   c. Perform a task analysis and determine what abilities a student may be lacking to make progress in learning a certain motor skill
   d. Explain the importance of vision in learning and control of motor skills
   e. Explain what happens during the stages of learning and how that can be used to determine what stage a learner is in
   f. Explain the processes of learning, memory, retention, and transfer and show what can be done to enhance memory and transfer of movements
   g. Explain the effect of feedback on learning and performance, and the "best way" to use feedback to enhance learning
   h. Explain the variables affecting practice effectiveness, and the "best way" to organize practice in order to obtain the greatest amount of learning.

3. Reasons for Changing to Team-Based Learning

- Previous way of teaching:

    - Used primarily lectures, small group in-class lab assignments, small group term presentations, and think-pair-share.
- Problems encountered:
    - Student gave me blank stares, dozed off, doodled, had low energy, were disengagement, and uninterested in the content.
    - Poor interaction and low energy exchange between students and me during the class sessions.
    - Poor long-term retention and performance on tests; little skill in applying principles; analysis, synthesis, evaluation questions left them stumped.
    - The lethargy drained my enthusiasm for teaching and my energy as a teacher in the classroom.

4. Changes Made

- Changes made: Implemented the entire team-based learning strategy in the Fall of 2001:
    - Semester-long permanent teams
    - Readiness assessment procedure: Individual Readiness Assessment Tests (RAT), team RAT, team appeals
    - In-class group application activities and assignments
    - Self-assessment of assignments using rubrics
    - Teamwork behavior evaluation of each team member at the end of the semester
- Initial reaction of the students:
    - Students have a difficult time with teamwork during the first number of weeks in the semester. Once they get used to the structure, they start enjoying their teams. It takes about half a semester for them to "gel." I had some trouble with one team so far, because of strong personalities but the problems were worked it out by speaking to the individual in question.
- Subsequent reactions? See below (#6: Impact)

5. Examples of Team Assignments

Here are descriptions of three assignments I use during the course. The appendix includes a fuller description of these exercises plus one culminating exercise that I use near the end of a major unit.

- Example #1: Following an exercise in which pairs of students perform (or try to perform) specific physical tasks, the teams decide whether or not their observations of the performing individuals are in line with the predictions of Hick's Law. Hick's Law predicts that, when we double the amount of information that needs to be processed, Reaction Time will increase at a constant rate.

Following this, students are given a hypothetical situation in which a man is driving his child to school and is bombarded with multiple demands: bickering children, ringing cell phones, phone conversations, etc. As a result, he almost has a car accident. The teams are then asked to decide whether the driver's performance can best be explained using Hick's Law or Kahnemann's Attention Theory and to justify their choice.

- Example #2: The teacher posts a list of 6 actions that a physical education teacher might take to facilitate positive transfer from one motor skill to another. The teams then post their choices and are given time to explain the reasons for their choice. This process has resulted in a civil, intellectual exchange of ideas and really engages the students to listen to and think about different perspectives and viewpoints, as well as to question each other on relevant thinking.
- Example #3: The teacher gives a definition of a key concept (e.g., negative transfer). Teams are then asked to select which of 4 hypotheses best explain why this concept occurs. The teacher also introduces standards for quality explanations, based on Richard Paul's work on critical thinking, e.g., Clarity, Accuracy, Precision, Breadth, Logic, and Significance.

6. Impact

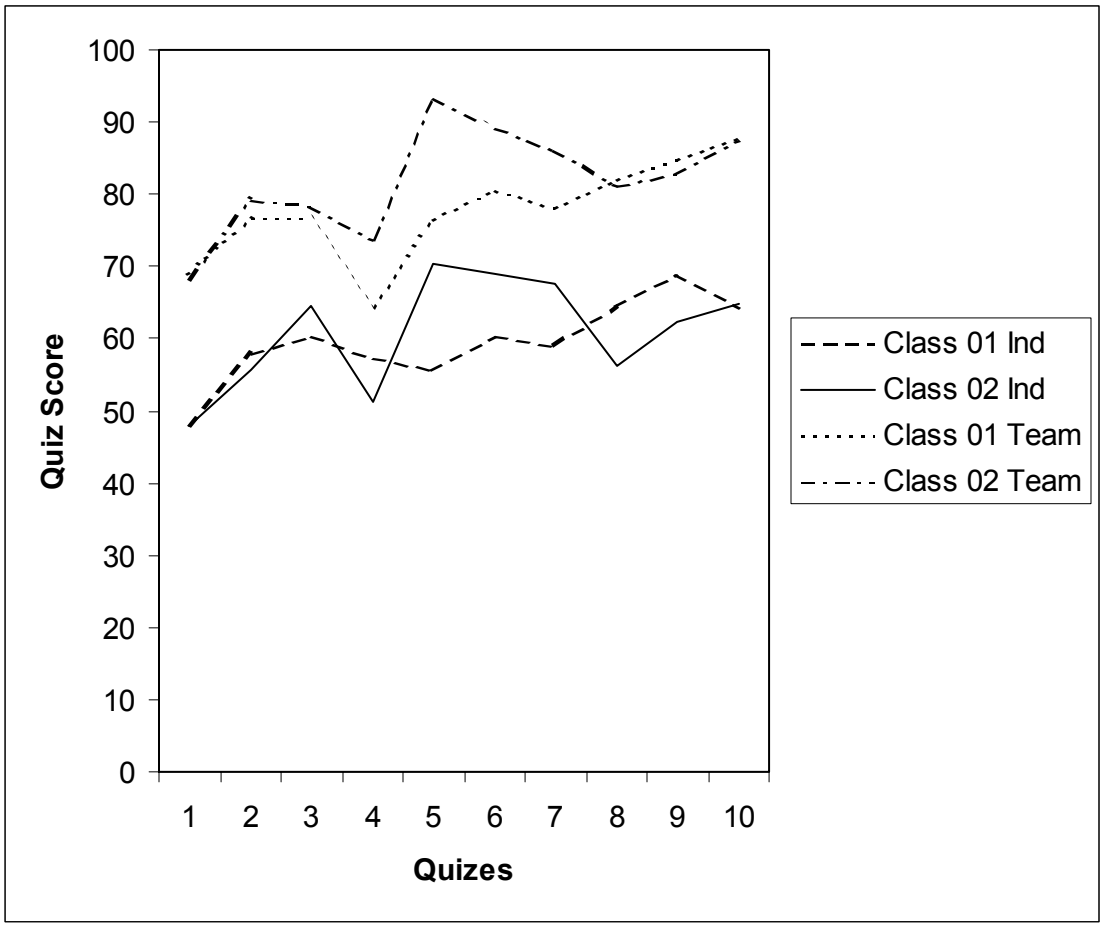
A. On Student Learning and Performance:

Regrettably I failed to use the same final exam before and after introducing team-based learning. Consequently, I cannot offer data indicating whether the students who experienced the team-based learning strategy learned more about the content individually compared to the traditionally taught students.

Nonetheless, based on my observations in the classroom of the discussions the students had among themselves about the content, I believe that they would have performed at least as well and probably even better than the students who were taught with the traditional lecture format.

I did analyze the performance on the RAT scores across the semester and found that the scores by both individuals and teams improved significantly across the 10 quizzes (see Figure Below). Moreover, scores on the Team RATs were about 20 points higher than on the individual RATs. These effects were statistically significant.

Note: The decreases in performance for RAT 4 and RAT 8 seemed to be due to the larger amounts of readings for these two RATs. Students also complained about the amount of reading for these two.



B. On Student Attitudes

- **The teacher's observations about changes in students' behavior and attitudes toward learning in this course:**
  - students studied the material before coming to class;
  - students were able to discuss concepts from the text without preceding lecture;
  - team RAT scores were usually higher than the individual score (with regular exceptions);
  - students were able to develop coherent reasons for an appeal of RAT questions;
  - students really liked being in a team for the entire semester;
  - students learned how to perform as a team and were proud of their accomplishments;

- students realized the benefits of diversity within and among their teams;
- students learned how to carry on a team discussion and come to consensus or an agreeable solution;
- the team learning approach engaged and motivated many more students than in previous classes;
- they practiced and showed higher level thinking and reasoning skills;
- they made new friends;
- they enjoyed themselves.

- **STUDENTS' COMMENTS** about the impact of team-based learning on their work in the course. This was gathered in four ways: Student Surveys, Focus Groups, One-Minute Papers, and a Survey of Their Reaction to Team Performance.

1. Comments from STUDENT SURVEYS about team behavior:

- "[The RATs] made me read before class. I took it more seriously."
- "Each person had to learn, not just memorize the information"
- "The team test and the feedback were most important to our members"
- "As a group we view different angles and approaches to the questions, and the repetition sinks in."
- "Other people's ideas helped one to understand the material individually"

2. FOCUS GROUP Evaluation Comments

The students were asked about their experiences with team learning during the focus group evaluation at the end of the semesters in each class. A person from the UTEP Center for Effective Teaching and Learning (CETaL) conducted this evaluation. Examples of positive statements expressed by students were:

- "Sharing knowledge with team mates;

- Explain information to each other;
- Help get teammates prepared;
- Didn't want to let teammates down;
- More ways than one to look at something;
- Helped clarify and synthesize information;
- Collective knowledge is greater than individual;
- Teammates helped my grades;
- Accountability towards my team mates."

These comments suggest that the students appreciated and acknowledged the intended benefits of team learning. I analyzed the ratio between negative and positive comments for the focus group evaluations: Percentage negative comments = (negative/(negative + positive))*100. The results are shown in the Table below. Note that the percentage of negative comments related to the RATs remained similar, while that percentage dropped slightly for teamwork. The drop was substantial for the Assignments category mainly due to the incorporation of poster presentations in the class. Numerous positive comments about teamwork were about the posters as well.

Fall 2001			Spring 2002		
RAT	Teamwork	Assignments	RAT	Teamwork	Assignments
22.22%	34.83%	11.93%	22.76%	31.78%	4.07%

Percentage of negative comments among the total number of positive and negative comments given by students during the Focus group evaluation at the end of the Fall 2001 and Fall 2002 semesters in the three categories of Readiness Assessment Test (RAT), teamwork, and team assignments.

3. One-Minute Papers

Students completed 1-Minute Papers (a classroom assessment technique) in order to provide the instructor with feedback about the teamwork assignments. Numerous valuable comments were expressed and the following two are examples.

"...allowed me to really go over the material, get a firm understanding of the relationships between learning, memory, and forgetting and skill performance, and just, in general, be more prepared. Beforehand, just the process of trying to think of potential questions the other teams might ask, also drove the material home for me."
"…. It allowed me to comprehend how memory works because I was able to see how the other groups thought of it. This time around everyone's posters were very different so I was able to see the process from different points of view."

4. Team Performance Survey

A survey related to teamwork was given at the beginning and end of each semester. The questions gave students a chance to voice their opinion about multiple aspects of team learning. Their responses to the following questions changed for the better over the course of one semester as shown in Figure 2:

1. Performing assignments in small groups always results in one or a few persons doing all the work
2. There is always one person who tries to get away with doing as little as possible
3. There is always a person who abuses the trust of the others by bringing up excuses why he/she could not complete the assigned work on time and with quality.
4. There is always one person who doesn't show up during the agreed upon meeting times outside of class when we're supposed to work on the assignments
5. Team assignments often result in frustration and anger in some team members
11. Most team assignments in class are ineffective, because the teachers often don't give the students immediate feedback about their performance/opinions.
13. Team assignments don't make students work harder for the class
15. When you have to complete team assignments outside of class it is always a hassle to organize meetings.
16. When performing team assignments in class, students mostly socialize instead of work on the task
19. Team projects enable less motivated or less capable students to go along for a "free ride" and get a good grade on the backs of the hardworking students.

As shown in Figure 2 below, the students at the end of the course gave *lower* scores to these questions, indicating that their team experiences made them feel more positive about these items.

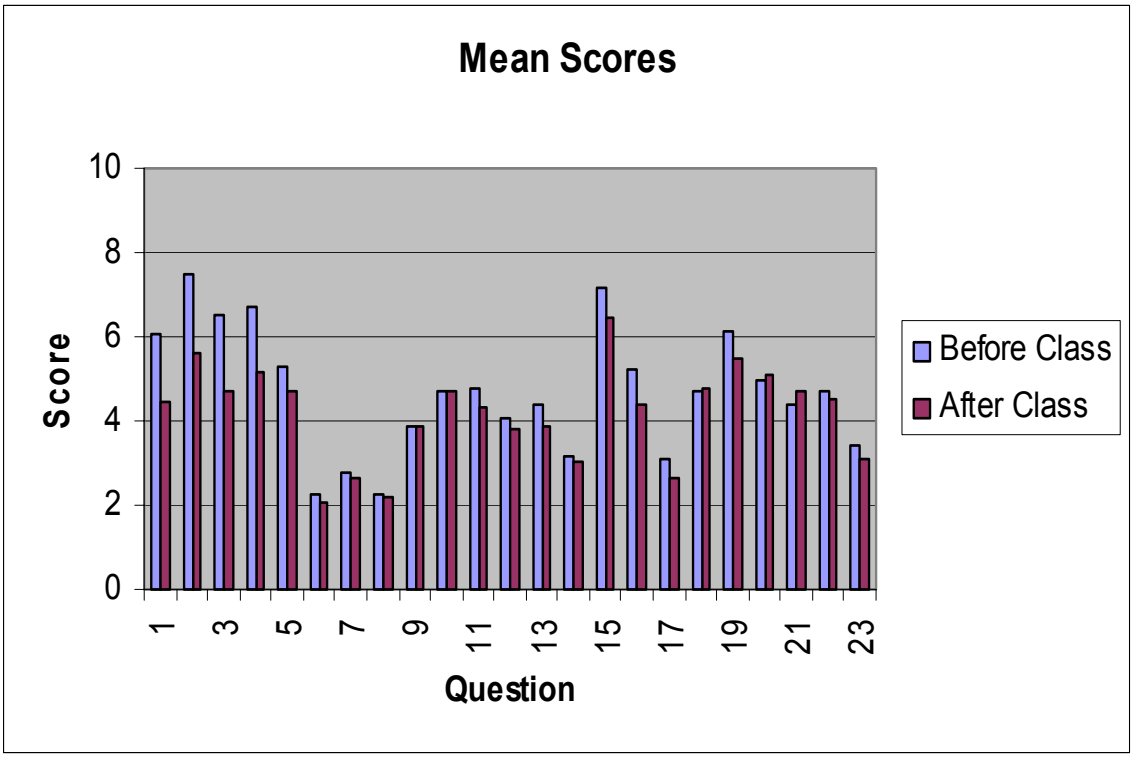


Figure 2. Responses on Questions 1, 2, 3, 4, 5, 11, 13, 15, 16, and 19 changed significantly from beginning to end of the semester, reflecting an improved perception of teamwork by the students.

NOTE: Lower scores mean better student reactions to team-based learning.

C. Impact On the Teacher

- Adopting team-based learning restored my enthusiasm for teaching, and convinced me that I could actually be effective in helping students learn content and a lot more; such as working in highly performing teams, their relationship with others, being aware of their own impact on team performance, and building their self-confidence in speaking and performing in front of others.
    - Demands on my time were within acceptable levels. The course requires many more management actions and time than the old version, but the increase in energy level alone in class was worth the change and the additional time commitment. The comfort of being

part of a team and having that group support allowed more students to speak up in class. When I pose a class-wide question, many students now volunteer to answer it unlike before. There is just no comparison to my former teaching strategies. The classroom now hums because students are working instead of being dead silent and sleepy and I don't get complaints about non-participation anymore.

- The most difficult part for me is writing effective assignments. Even using the guidelines it takes quite a bit of thought and revision to get it right. Nonetheless, even the assignments that do not lead to a strong "give-and-take" discussion engage the students much more than traditional lecture. A side issue is that Kinesiology students tend to prefer to engage in physical activity: they learn better by physically doing.

7. Related Publications

An article was being submitted for publication in the Fall of 2002 to the Journal of Teaching in Physical Education.

8. Contact Information

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9. APPENDIX: More Detailed Information about Team Assignments and Products of the Teams' Work

In-class assignments on transfer of learning

Example 1:

I have students find a partner within their team. Partner One folds a one-dollar bill and holds it by the top so the long end hangs down. Partner Two places thumb and index finger in a grasping position at the bottom of the dollar bill. Partner One drops the bill unexpectedly and Partner Two tries to grasp it before it falls past the thumb and index finger. They perform this task a few times and switch. For the second part Partner One than takes out a second dollar bill, folds it lengthwise, and holds both bills up by their tops. Partner Two places the left thumb and index finger in a grasping position at the bottom of one bill and does the same with the right thumb and index finger. Partner One drops one of the two bills unexpectedly and Partner Two tries to catch it. Typically, they are sometimes able to catch the bill when only a single bill is held, but they do not succeed catching a bill when two are held up. Following this experience, the teams must then decide whether their individual observations are in line with the predictions of Hick's Law. Hick's Law predicts that when we double the amount of information that needs to be processed Reaction Time will increase at a constant rate. If the assignment ended here we would not get a lot of "give-and-take" discussion. A final scenario/case study related to the experience completes the assignment.

> "Mr. Jackson was driving his 3 children to school early in the morning. He had not slept very well because the baby had been sick during the night and kept him up. The children's bickering in the back seat was annoying him. Wanting to find out what had happened at the office while he was in a meeting yesterday afternoon, he picked up his cell phone and reached for the speed dial. His secretary answered the phone while he arrived at a busy intersection of two roads with a 4-way stop sign. He barely caught sight of the stop sign and jumped on the brakes bringing the car to a screeching halt. His heart thumped in his chest as he tried to catch what his secretary was telling him about the fight she had with one of his subordinates and that this person had thrown the coffee pot at her. While she was telling him this, he visually focused on the car waiting for the stop sign to his left. At that time his oldest child yelled in his other ear that he needed to move because everybody was waiting for him. He stepped on the gas not seeing that the car on his right had pulled up into the intersection and that he was about to hit this car. The driver of the other car slammed on the brakes and hit the horn, giving Mr. Jackson an adrenaline jolt that made him throw the cell phone at his oldest child, grab the steering wheel with both hands, and nail the breaks leaving tire tracks on the intersection. He thought he just had a heart attack as he smiled sheepishly at the other driver

before driving slowly through the intersection. The rest of the trip, Mr. Jackson focused on the traffic and delivered his kids safely at their schools."

Your Task:
Select whether Mr. Jackson's performance can best be explained using Hick's Law or Kahnemann's Attention Theory. Justify your selection.

Example 2

For this assignment, students must select which of the actions a physical education teacher can take to facilitate positive transfer from one motor skill to another is the most effective one from a list of 6 alternatives. Students must first come to agreement as a team on which action is the most effective using the assigned reading materials and references. Following the selection within each team, one member writes the team's name and its choice on the board. After all teams have posted their choices, an organized classroom discussion follows in which each team is first given the opportunity to present the reasons for their selection. The teams are then given the opportunity to critique/question each other's choices. This process has resulted in a civil, intellectual exchange of ideas and really engages the students to listen and think about different perspectives and viewpoints, as well as question each other on the reasons.

Example 3

The next assignment is similar in structure, but the intent is to have the students increase their understanding of different hypotheses and critically analyze the evidence that lead to these hypotheses. Furthermore, I want expose the students to the process of how formal explanations of certain phenomena are developed so they understand the strength and weaknesses of a hypothesis that purports to explain a set of observations. The students are given the following preamble:

"Negative transfer is something teachers and therapists want to avoid, because it hinders the continuance of the learning process. It occurs when a previously learned task negatively affects the performance and learning of a new task. Select one of the following choices to explain why negative transfer occurs. If you select alternative (d) you must present an alternative hypothesis that does explain negative transfer. Come to a consensus as a team on what you believe is the best option. Have one team member write your choice on the board under your team's name. Discussion of your choices will follow. Your choices are:

a) Identical elements hypothesis
b) Transfer-appropriate processing hypothesis
c) Specificity of practice hypothesis
d) None of these explain negative transfer"

On most of the assignments I ask the students to consider the following critical thinking standards when they develop their reasons for their choices. These are based on Richard Paul's work on critical thinking. It appears to help them present their reasons more clearly and with greater substance.

- CLARITY: Could we elaborate further? Could we give an example?
- ACCURACY: How could we find out if what we say is true? How could we verify or test it?
- PRECISION: Could we be more specific? Could we give more details?
- BREATH: Do we need to consider another point of view? Do we need to look at this in other ways?
- LOGIC: Does all this make sense together? Does what we say follow from the evidence?
- SIGNIFICANCE: Are these the most important things to consider in our decision?

Poster Presentations

The student teams also complete three Poster Presentations. The comments below describe the assignment for the third Poster Presentation and give examples of what two teams produced in response to this assignment.

Poster Presentation III: Augmented Feedback

(Objectives I. b, II. f, g)

Research has uncovered the many new ways in which feedback can be applied more effectively when teaching than the old ways when teachers were told give feedback immediately after every attempt and to not let students make any mistakes. You are to identify the different ways in which feedback can be applied effectively and synthesize this information in what you believe is the ***most effective way*** to use feedback when teaching a beginner. In other words, your poster should tell a teacher/therapist/instructor how to provide feedback such that it leads to the greatest amount of learning. Your answer should be a compilation of the different ways of providing feedback presented in the textbook. Of course you will need to back up your synthesis with clear reasons.

Steps to completion (you will have 10 min to complete the poster and get it on the wall):

1. Individual Homework before class:
    a. Study the information related to augmented feedback using the TTC

   b. Study the different manipulations of feedback: Compare and contrast the results.
   c. Determine how these different feedback manipulations affected performance of the learners
   d. Now determine which manipulations you would use to get the greatest learning benefits out of providing augmented feedback to a learner. Make sure you can back up your choices.
2. Team activities in class (we'll take on hour of the class period):
   a. Bring everyone's ideas together in discussion
   b. Finalize the team's synthesis of the information: Create drawings, diagrams, key words, arrows, lines, etc. and put your ideas on the large sheet of paper provided to you.
   c. Write a half page narrative summary explaining your model if needed. Tape it to your big sheet.
   d. Hang your sheet on the wall

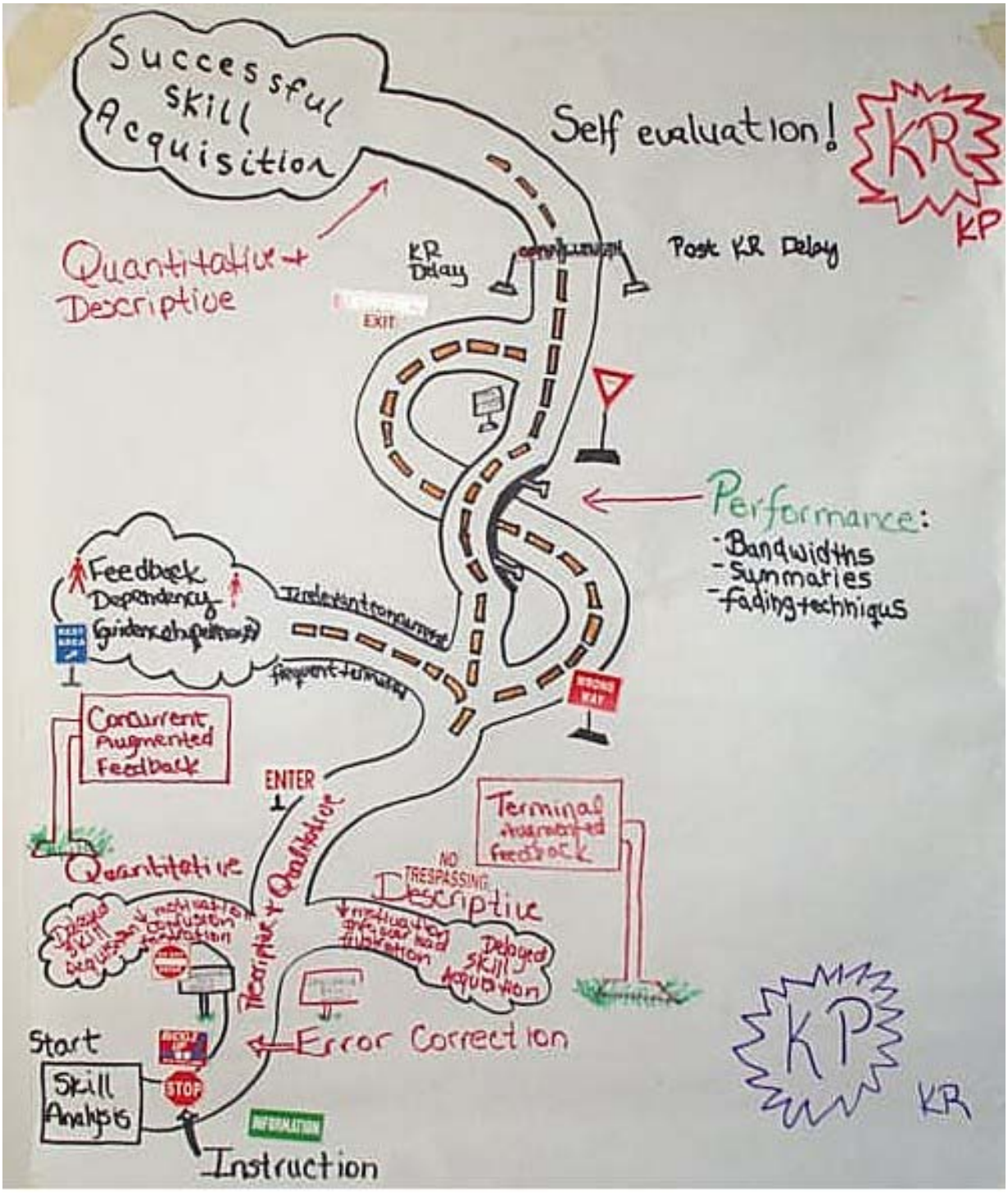
Assessment and Evaluation of Posters (70 min):

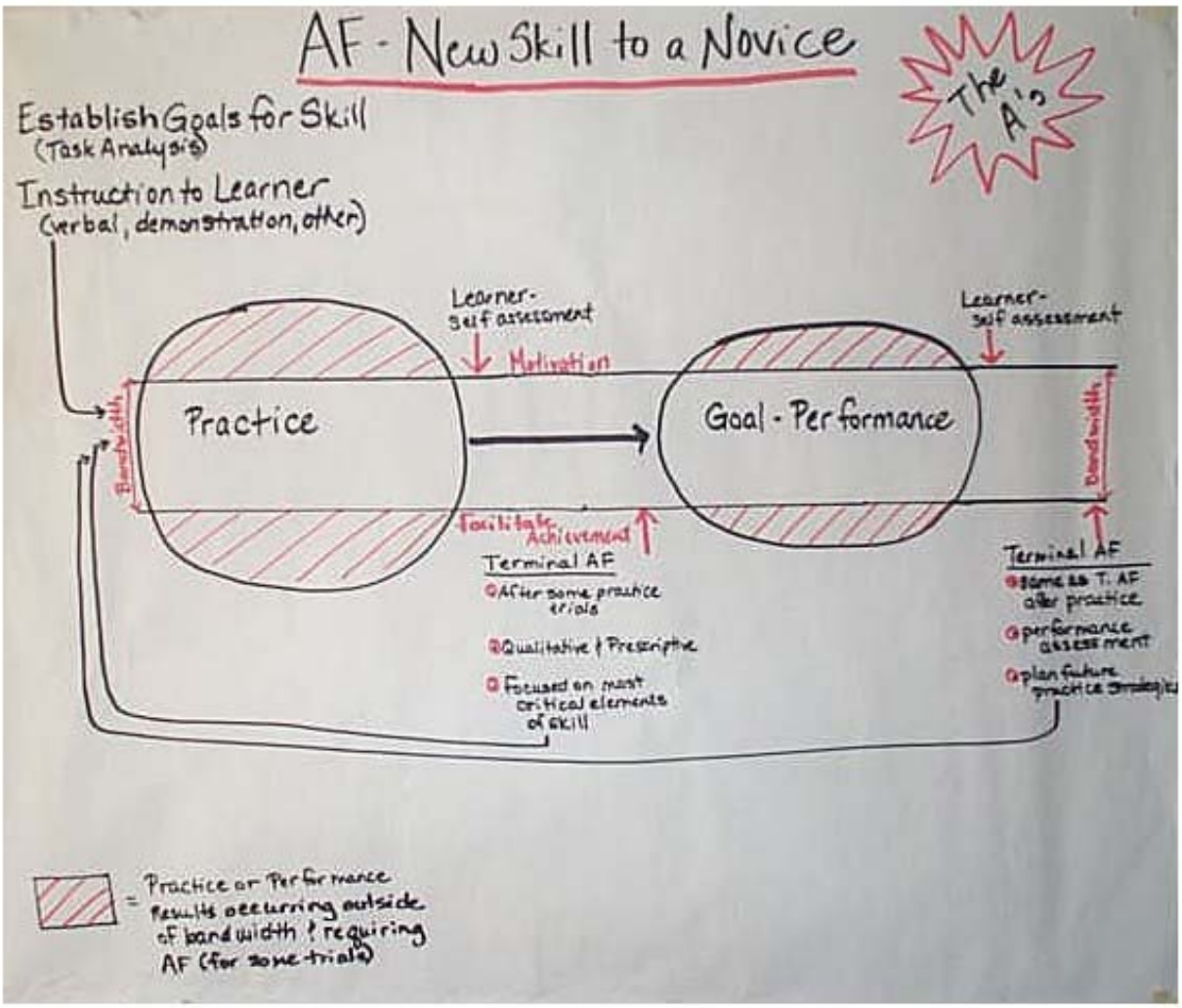
1. One member of the team will stand next to the poster to answer any questions using, if necessary, the brief written narrative (no more than half a written page) the team composed,
2. The other team members examine the other posters by questioning the presenter, asking for clarification of the *purpose, information used, assumptions made, inferences drawn, point of view, and implications/consequences* of the model and the reasoning behind it. Keep track of the questions you received as presenter and the answers you got as an examiner.
3. All teams have 30 minutes to examine all models and identify strengths and weaknesses using the rubric and guidelines. You can go back and forth to consult with your team members.
4. The teams will then have 20 minutes to comment on one randomly selected model. The comments must be written using the guidelines.
5. The completed comment sheet is placed on the associated model. Valid comments of another team's model can earn the team who commented on the model 1 bonus point for each category (*purpose, information used, assumptions made, inferences drawn, point of view, and implications/consequences)* for a maximum total of 6 extra points to their grade.
6. Each team will have 10 minutes to reflect on the comments, assess their validity, and write a rebuttal. The instructor will also assess the validity of these comments before bonus points are given.
7. Debriefing 5 minutes.
8. Following the completion of the presentations and comments, each team will grade their own model using the Rubric for Poster Presentations.
9. Each individual student will complete a 1-minute paper

Examples of Poster Presentations

The following two posters were the results of Poster Assignment III in the Spring of 2002. The variety of products reflecting the diversity in solutions to the problems really impressed the students. Some were a bit more accurate than others, but the assignment forced students to deal extensively and deeply with the content. The were required to synthesize information to construct the posters, then analyze each other's posters and evaluate them. They assessed and graded their own and the other teams' posters using a rubric.

(Note to the reader: these posters may be meaningless because they lack the explanation students were allowed to present orally to the other teams. One representative of each team was required to stay with the poster to answer any questions. This was of great benefit to several students who commented that they surprised themselves with their ability to present explanations to others. This activity clearly built their confidence.)


Successful Skill Acquisition
Self evaluation!
KR
KP
Quantitative + Descriptive
KR Delay
Post KR Delay
EXIT
Performance:
-Bandwidths
-Summaries
-fading techniqus
Feedback Dependency
Concurrent Augmented Feedback
ENTER
Terminal Augmented Feedback
NO TRESPASSING
Descriptive
Quantitative
Recurrent + Qualitative
Delayed skill acquisition
Error Correction
Start
Skill Analysis
STOP
Instruction
KP
KR


AF - New Skill to a Novice
The A's
Establish Goals for Skill
(Task Analysis)
Instruction to Learner
(verbal, demonstration, other)
Learner-
self assessment
Motivation
Learner-
self assessment
Practice
Goal - Performance
Bandwidth
Bandwidth
Facilitate Achievement
Terminal AF
After some practice trials
Qualitative & Prescriptive
Focused on most critical elements of skill
Terminal AF
same as T. AF after practice
performance assessment
plan future practice
= Practice or Performance results occurring outside of bandwidth & requiring AF (for some trials)