Team Oriented Performance Education (TOP-ED) Concepts and Techniques Used in Aviation Education

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Abstract

A report on the development of, and research on, a cooperative learning application called Team Oriented Performance Education (TOP-ED). TOP-ED is currently being used in certain undergraduate university classes at the Arizona campus of Embry-Riddle Aeronautical University. TOP-ED, is patterned after the aviation industry's developing Crew Resource Management (CRM) principles. This report will explain the techniques used in TOP-ED and the emerging results of this new application of cooperative learning.

Introduction

As training in Crew Resource management (CRM) in the aviation industry continues to pick up momentum,[1] Embry-Riddle Aeronautical University (ERAU) is exploring the application of CRM concepts in the classroom environment. At ERAU in Arizona a new approach of teaching academic subjects is being tested. The concept is called Team Oriented Performance Education or TOP-ED. TOP-ED, patterned after the CRM model, is entering its third year of development and testing.

As the aviation industry has matured and the technology of aircraft has become more reliable, the human factors of accident prevention have grown in their importance. The vast majority of aircraft accidents have human factors as a main or contributing cause. Only a few are caused by the lack of technical skill on the part of the pilots. Most of the human factors related accidents are caused by the failures of the humans to interact with each other in a way that promotes safety.[2] It boils down to people's ability to work with people effectively in the team setting.

It is only fitting that ERAU, standing at the forefront in aerospace education, should step in to lead the way in the development of classroom techniques of cooperative learning which will not only give students the technical competence in subject areas, but give graduates the skills to work effectively in teams also. With these goals in mind, in early 1995, the Aeronautical Science and Flight Department CRM Committee recommended an aggressive study of ways to implement the concepts of CRM in the flight training programs and classroom instruction of the Arizona campus.

The concept of cooperative learning and the techniques used to implement it are not new to education generally, nor to Embry-Riddle in particular.[3] Lab partners and team projects are used in an increasing number of courses to stimulate student participation, enhance application, and increase understanding of the subject matter.[4] The difference with TOP-ED is that it is designed to give the student the opportunity to learn and practice performance in a team. Using an industry model for CRM in the cockpit, students are organized into "crews" of three, with one being designated as "Captain" and the two others being given responsibilities as "First Officers." The crew's mission becomes the task of achieving the learning outcomes which indicate they have mastered the subject matter in the course.

Method

Background for Initial Concept Development

The classroom application of TOP-ED was initially conceived for use in pilot skills oriented courses such as the Navigation series. Although limited student team projects have previously been applied, full implementation of the earliest version of TOP-ED was initially tested in the

last third of the Spring '95 semester in one All-Weather Navigation section. Because the results of this test were very encouraging, full course developmental testing of the concept was accomplished during the Summer "B" '95 term with a small All-Weather Navigation class. Expanded implementation and testing was conducted during the fall semester ('95) with four sections of the All-Weather Navigation course. Two of the sections used the TOP-ED concept and two followed a traditional approach. The sections were matched as research and controlled groups to evaluate and refine the instructional innovation. Continued development and testing of TOP-ED in the Principles of Navigation course was also conducted during the spring ('96). The four spring '96 sections (two test and two control groups) were accomplished using applied refinements to enhance student motivation for individual preparation. In the fall ('96) semester, another two sections of All-Weather Navigation were set up as test and control groups.

In addition to the testing of the TOP-ED in the pilot skills oriented course of All-Weather Navigation, development and testing has been conducted on the Human Factors in Aviation Safety Class. This course is considered more of a traditional, academically oriented class, not necessarily geared exclusively for pilots. The application of the concept was first developmentally tested in the Human Factors in Aviation Safety class taught during the summer "B" ('95) term. Continued developmental testing was also conducted during the summer "A" ('96) term with the refinements and application of a personal preparation motivation element similar to that used in the All-Weather Navigation classes. Since no alternative sections were offered to provide control groups, expanded full scale development testing was delayed until the fall ('96) semester.

Approach

Implementation of the TOP-ED concept includes organizing the class into teams, defining the responsibilities of each team member, specifying the tasks to be accomplished by the teams, creating criteria and methods for team members to evaluate each other in their roles, and developing a system for evaluating the effectiveness of the TOP-ED application.[5] Early stages of concept development, and preliminary refinements to those concepts were coordinated through the ERAU Arizona Campus Flight/Air Science CRM Committee. The team support and synergistic ideas of this committee have been very helpful in generation and refinement of the principles being explored in this cooperative learning application. All of the test and control groups have significant data bases of information collected and maintained on them for the purpose of studying the effect of the various elements of TOP-ED applications. An analysis of initial results has been compiled and continuing further analysis is underway.

Design of Full Course Test and Control Groups

Because the first two full course development tests were accomplished during the summer, when only one section of each course was offered, it became essential that further testing, with

simultaneous control groups be conducted to further explore actual student performance. It was determined that continued full course TOP-ED concepts testing would be focused solely on the All-Weather Navigation course. Four sections of the course were offered during the fall '95 semester. Two were selected as test groups and two were used as control groups. An extensive record of student performance was maintained in all four sections to offer comparisons among the students.

I was the instructor for all four sections of the All-Weather Navigation classes and used the same course instructor guide, student workbook, and student resource package for all students. The two sets of test and control groups were also given the same quizzes, flight plan exercises, computer exercises, and tests. Every effort was exerted to make the instructional approach the only variable. Learning outcomes were the same for both test (TOP-ED) and control (traditional) groups, except the TOP-ED groups had additional outcomes related to learning crew resource management skills through practical experience in crew performance teams. The TOP-ED groups also required additional instruction in the administrative aspects of the team approach and completion of the crew performance evaluations.

Establishing a Performance Baseline

The first seven units (about 3 1/2 weeks) of the course were taught with the traditional (lecture/discussion) style approach for all four sections. Student performance was assessed using one quiz, one flight plan exercise, one home work assignment and an individual performance assessment test over the seven units. Individual performance on the first test was used as the base for comparison to the team test taken by the TOP-ED crews at the 2/3s point in the course and the individual final exam. The control groups of traditional students were given the 2/3s point test as individuals. All students also participated in a team of two to complete a computer exercise assigned during the first week, and all of the students were encouraged to form their own voluntary study groups during the 3 1/2 week baseline period.

Frequently there were students taking the All-Weather Navigation class who had advanced instrument training experience and significantly greater flight experience than the average student participating in the course. There were several students with previous instrument and commercial certification, and even a few extreme cases, where a student had already received certification as an instrument flight instructor. As a result of these unavoidable anomalies in the predominant experience of students participating in the course, a previous experience and past student performance assessment was also conducted. This prior experience indicator, or seniority number, was kept attached to the individual student record and tracked for further refinement of the test and control groups for comparison analysis.

Organizing the TOP-ED Performance Teams

During the last two thirds (about 12 weeks) of the course the TOP-ED classes were divided into teams of three. A "Captain" and two "First Officers" were appointed for each team or crew. In an effort to equalize the experience levels in each of the crews, they were organized from three seniority pools. Students were assigned to the seniority pools based on their prior instrument and flying experience. A single seniority list was sorted for the class and divided into thirds. Top, middle, and lower third seniority pools were grouped together and student crews were formed with an individual from each seniority pool. Students were not told which seniority pool they were taken from, and only knew that each crew had a top third seniority individual assigned.[6]

In this first controlled testing, crew integrity was maintained. With only a few exceptions the same three team members remained together for the final 12 weeks. Crew responsibilities, however, were rotated among the students in the team, and each student was given the opportunity to serve as a captain once and as a first officer twice. Each captain presided over the crew with approximately the same amount of team tasking assignments to accomplish.

Performance Tasking of TOP-ED Students

Each TOP-ED crew grouping was given about 8 hours of designated class time to accomplish standard crew tasking assignments. The 8 hours of designated class time fell within about 3 weeks of time during a normal term. The general layout of the tasking the TOP-ED crews were required to accomplish consisted of following:

1. Completing units of study in the Student Workbook which included answering questions and indicating resource references.
2. Accomplishing a team quiz which was a spot assessment of the crew's achievement of learning outcomes in the Student Workbook study units.
3. Completing the flight planning for an IFR flight which included their application of the IFR procedures appropriate with current knowledge outcomes.
4. Completing a team homework assignment of 10 questions* designed to assess achievement of the initial flight planning learning outcomes. *(The high altitude, and final, Flight Planning Exercise homework had 20 questions.)
5. Completing an in-class Flight Plan Exercise assignment to assess learning outcomes of the total Flight Plan Exercise by the use of 15 questions* designed to measure "in flight" applications of IFR procedural knowledge. *(The first crew grouping was assigned the *13 Mike* scenario flight and team written report instead of the 15 question "in flight" applications.)
6. Accomplishing, and reporting, two hours of team study time outside of designated class time.
7. Accomplishing one set of Crew Member Contribution Evaluations.[7]

In addition to the standard TOP-ED crew tasking team grouping #2 accomplished a team test designed to assess the successful achievement of learning outcomes associated with IFR

procedures mastery during the first two thirds of the course. Also team grouping #3 completed a team computer exercise designed to demonstrate and assess understanding of the horizontal situation indicator presentations in the VOR and ILS applications.

Results

Student Opinion Results of the Initial Test Groups

A "Student Course Evaluation" has been administered at the end of the classes where TOP-ED was applied to evaluate student response to the concept. All of the student opinions received were very positive and show a strong potential for significant further application. A review of the major results is as follows:

a. The students stated they found the team approach was much better than the traditional approach to instruction.

b. They indicated they felt they were much more stimulated to participate in the learning activities of the team oriented performance class.

c. Many students felt they were able to master skills and knowledge associated with the subject of all-weather navigation much better than they would have by individual study sessions.

d. The learning of how crew resource management can be applied in an aviation context was considered a bonus outcome for most students.

e. A vast majority of the students said they would strongly recommend the TOP-Ed concept, with further research and refinements, be continued in the All-Weather Navigation and Human Factors in Aviation Safety courses.

f. A significant majority also felt the TOP-Ed concept of instruction, with further research and refinements, should be applied to more Aeronautical Science courses at ERAU.

g. Another interesting piece of information came from the "Student Course Evaluation" of the TOP-ED classes. A large percentage of students indicated they mostly studied alone. Less than 4% indicated they had any exposure to organized team study groups prior to their participation in TOP-ED.

Performance Results of the First Controlled Testing of TOP-ED

A set of three tables at Appendix A containing a summary of TOP-ED team performance and traditional individual performance were developed to assist in comparing the test with the control groups, and the results are recorded in the Performance Comparison Table. The following column summary and brief comparative analysis of the table is as follows:

Refer to Table 1 (pages 20-21)

(A) Combined Averages for Fall 1996 - Gives the breakdown by section of the TOP-

ED (Test) and traditional (Control) groups with the averages separating them. TOP-ED groups are presented first, with their respective control groups underneath them. Segr Ave = Segregated Average and applies to students participating from Section 05. N-Exp Ave = Not Experienced Average and indicates students without prior IFR experience. Exp Ave = Experienced Average and applies to students with IFR experience prior to coming to the AS 260 course.

(B) No of Stu - Indicates the number of students in each of the respective groupings. The average lines show the total for the respective groups. It is noted that there are more than twice the number of students participating in the TOP-ED teams than in the traditional groups.

(C) Type of Study - Identifies The test and control groups and their comparable partners, and the type of study used in the class for the delivery of the course material. Sections 03 and 04 were set up as the test groups for using the TOP-ED concept of course material delivery. Sections 02 and 05 were originally designed to be the control groups, however 11 of the students in section 05 persuaded the instructor to allow them to participate in TOP-ED. This reduced the traditional control group to only 7 students.

(D) Assign Senior Number - Is used to give a group identity factor of prior IFR experience as they started the AS 260 instruction. The seniority number was assigned to the individuals as they entered the last two thirds of the course and was determined by an individual's reported experience in flight courses, FAA certificates held, hours of flight experience, hours of instrument flight experience, and personal computer flight simulator experience. Also used to determine an individual's seniority number was their official grade in the prerequisite course, Basic Navigation (AS 240), their overall University grade point average (GPA), and the grade achieved in the first one third of the AS 260 course. It is significant to note that in each of the comparative groups the traditional students had a higher average seniority number for their group than the test students. The combined averages show the traditional group averaging a 26 point advantage. The inexperienced groupings shows the control group with a 14 point advantage. Traditional students with prior IFR experience were 6 points of seniority above the TOP-ED counter parts. It would seem reasonable to assume that any reversal of this traditional advantage in the recorded performance of the test and control groups would indicate TOP-ED has a possible positive influence on student performance.

(E) The first third of the course was taught using the traditional method of instruction in all classes. The evaluation of performance was derived from one quiz, one homework assignment, one flight plan exercise, and a test. This first third of the course evaluation constituted 25% of the total course grade. It is used as a base line for the individual performance for each of the students in all four groups. The combined averages show the traditional, control group, finishing the base line first 1/3 with a 5.39% performance lead. The inexperienced traditional groups average performance was 8.59% better than the TOP-ED group's average. Only the prior IFR experience TOP-ED students (who at this point had received only traditional instruction) had a performance score of 6.52% points better than their control group counterparts. Refer to Table 2 (pages 22-23)

(F) The second test was weighted at 12% of the total course grade for all students, and the TOP-ED students took it as a crew. Comparing results in this column is looking at the

performance of individuals as they compare to the performance of a team on the same tasking. It would be expected that the averages of group synergy would produce better results than the averages of the individuals. The combined averages show a slight reversal of this expectation with the traditional students scoring slightly (1.5%) better than their TOP-ED counterparts. The expectation is verified in both the inexperienced and experienced groupings. TOP-ED shows a very slight (.83%) performance lead over the control group in the inexperienced groupings, and a 6.52% lead with the experienced groupings.

(G) Team Perfo - Shows the performance of each of the groups during the team tasking events. (The traditional, control group, students accomplished these as individuals.) It includes the average of 4 quizzes weighted at 4%, 7 homework and computer exercises weighted at 8%, 3 flight planning exercises weighted at 9%, and Test 2 weighted at 12%. The value of crew synergy is verified in th recorded performance results in this broader field of tasking. TOP-ED teams are better in every grouping. The narrowest margin is with the combined groupings (1.09% points), and the greatest with the students who have prior IFR experience (8.32% points).

(H) 2/3s Grade - Includes the individual performance of the first third factored in at 25% plus the last two thirds weighted at 33% for the total of 58% of the course grade. The last two thirds of the course were taught using TOP-ED for Sections 03, 04, and 11 of the 18 students in Section 05. The traditional methods were used in Section 02 and for 7 of the 18 students in Section 05. (Note: The vast majority of the time the TOP-ED crews of Section 05 sat in on the presentation given to the traditional students.) As would be expected, a comparison of the scores shows similarity to those of the first third.

(I) I-Fact 2/3s - 1/3 - Allows a comparison of the improvement (or lack thereof) between the student performance from the first third base to the course as a whole to that point. It is the total combined performance tasking for the course to that point minus the first third score. Here the TOP-ED students show greater improvement in every grouping. The inexperienced groups show the greatest difference, with test groups 6% more improvement than their traditional counterparts. The least difference is in the IFR experienced student groups with TOP-ED only 1% point ahead.

(J) T-Cont Total - Is the average of the crew member evaluations. Those participating in TOP-ED had actual Team Member Contributions averaged. The traditional, control, groups were given the same averages as their corresponding test group, since they did not complete these evaluations on each other. Section 05 (with the combined TOP-ED and traditional in the same classroom) were given the averages of the 11 students who participated in TOP-ED.

(K) Total Team - Is a sum of the team performance grade (column G) and the team contribution grade (column J).

Refer to Table 3 (pages 24-25)

(L) Before Final (83%) - Is the total of all performance evaluations except the final exam. It is the sum of two thirds grade (column H) at 58% and the team contribution total (column J) at 25%. It is noted that the traditional combined and inexperienced student groups

have a slight advantage on the final exam, but the TOP-ED students with IFR experience finished with a 5.45% lead over their traditional contemporaries.

(M) Final Raw - Shows the averages for the final exam. The final exam was taken by all students as individuals and became the basis of assessing each individual's performance throughout the course and their individual achievement of the course learning outcomes. The weight of the final exam for all students constituted 17% of the total course grade. Scores show that in all cases the traditional students, studying alone, and then taking the final exam as individuals, had averages better than the TOP-ED students. The combined average of traditional students was 9.83% better, the inexperienced students averaged 8.33% better than their contemporaries, and the experienced students in the control groups did 5.5% better than the test subjects.

(N) Course Overall - Is the sum of all performance (column L) plus the final exam (column M). Again, except for the prior IFR experienced student groupings, the traditional student groups lead the TOP-ED subjects by better than 2% points.

(O) I-Fact Final - 1st 1/3 - Gives the difference between the first third (column E) and the final exam (column M). It allows a comparison of the improvement (or lack thereof) between the student performance from the first third base to the final exam. This compared individual performance before TOP-ED with individual performance after TOP-ED. In this comparison the TOP-ED students with prior IFR experience showed a negative score and their traditional counterparts were 12.02% points ahead of them. The inexperienced TOP-ED students were only .25% points ahead of the traditionals. This combination of performance drove the combined average to favor the traditional group's average by 4.45% points.

(P) I-Fact Course - 1st 1/3 - Gives the difference between the first third (column E) and the overall course grade (column N). It allows a comparison of the improvement (or lack thereof) between the student performance from the first third base to the final overall course grade. This compared individual performance before TOP-ED with all performance, team and individual performance on the final exam. Except for the IFR experienced TOP-ED students, the other test groups did better than the control students. The inexperienced TOP-ED students seemed to gain the most from this comparison, showing 5.8% points above the traditional peers.

Discussion

Continued Testing of TOP-ED

The main adjustments in the second full course testing, which make it different from the fall '95 experiment, were changes designed to establish more individual accountability for students in the TOP-ED crews. This was accomplished by breaking up each crew and rearranging the crew assignments for each grouping of the teams. We not only rotated crew member duties in the crew but also rotated crew members among the teams. This should help reduce the tendency to inflate the Crew Member Contribution Evaluation. In addition the team makeup mixing, a system of no-notice individual preparation checks (IPCs) was used to assess individual preparation. These IPCs consisted of reference checks taken from the Student Workbooks, spot questions on the unit concepts, and selected isolation of crew members during

"team quizzes." Good performance on IPCs was not only rewarded by an individual performance incentive, but the associated crew members were also given a bonus for having an individual crew member do well on the IPC.[8] It is anticipated that this incentive system will enhance individual accountability for personal preparation by increasing crew, peer pressure for individual excellence. It should also reduce the tendency of the "let the other guy do it" mentality which is the most probable cause for the slightly lower individual performance on the final exam of those students who participated in the TOP-ED crews during the initial controlled testing during the Fall '95 semester.

Conclusions Resulting From the Limited Testing

1. Students who have participated in the TOP-ED concept of instruction feel they perform better using team performance oriented education.

2. Crew synergism, on the average, results in a higher standard of performance in achieving learning outcomes than the average of individuals performing on the same tasking.

3. An individual performance average, measured by an individual final examination, shows students participating in TOP-ED applications did not score as well as the average for those using the traditional approach of study.

4. If we assume that there is a trade-off for what the TOP-ED crews achieve in learning crew resource management (CRM) applications, a further study of crew performance compared to individual performance must be examined more fully in the future.

5. The results of this semester of testing the TOP-ED concept of instruction show that further research is needed to develop and apply team concepts which can be used to achieve the best in student performance, both as an individual and as a crew member, in mastering the performance outcomes of All-Weather Navigation. Further research and development is also needed into the value of the TOP-ED concept as a tool for increasing an individual's ability to perform more successfully as a member of a team.[9]

6. There may be a tendency for students participating in TOP-ED applications to reduce their individual preparation, feeling they can "let the other guy do it" in the team scenario. Further study and testing must be conducted to find effective ways of increasing a student's incentive to perform better as an individual on an evaluation as an individual. This should also increase the student's ability to make an increased contribution to the team as well as insuring the achievement of the course performance outcomes. When the TOP-ED concepts are developed fully, the individual performance of a participating TOP-ED student should be equal to or better than the traditional peer.

References

(1) Wiener, Earl L. , Kanki, Barbara G, and Helmreich, Robert L. 1993. Cockpit Resource Management, San Diego, CA: Academic Press (p. 3).

(2) Schwartz, Doug. 1993. "Maintaining Operational Integrity Through The Introduction of Human Factors Training." The CRM Advocate , Issue 93.1 (p. 1).

The remainder of the references listed were found after the development and testing of TOP-ED was in its second year. They are cited as authoritative support for the ideas developed in the application of CRM concepts to this innovation in cooperative learning.

(3) Johnson, David W., Johnson, Roger T., and Smith, Karal A. 1991. "What is Cooperative Learning?" Cooperative Learning, Increasing College Faculty Instructional Productivity, ASHE-ERIC Higher Education Report No. 4 (p. 4).

(4) Cooper, Jim. May 1990. "Cooperative Learning and College Teaching: Tips from the Trenches." The Teaching Professor 4: 1-2.

(5) Whipple, William R. October 1987. "Collaborative Learning: Recognizing It When We See It." AAHE Bulletin 40: 3-5.

(6) Cooperative Learning, (pp. 60-64)

(7) Cooperative Learning, (p. 66)

(8) Slavin, Robert E. November 1983. "When Does Cooperative Learning Increase Student Achievement?" Psychological Bulletin 94: 429-45.

(9) Bonwell, Charles C. and Eison, James A. 1991. "Additional Strategies Promoting Active Learning." Active Learning, Creating Excitement in the Classroom, ASHE-ERIC Higher Education Report No. 1 (p. 45)

Appendix A

Table 1

A Comparison Table for Team Oriented Performance - Education (TOP-ED) at Embry-Riddle Aeronautical University in Arizona

A	B	C	D	E
Combined Averages for Fall 1996	No of Stu	Type of Study	Assign Senior Number	First 1/3 Grade (25%)
Sec 03 (MWF) Comb Ave	12	TOP-ED - B Test	100	57.92%
Sec 04 (MWF) Comb Ave	27	TOP-ED - A Test	124	75.04%
Sec 05 (TTH) Segr Ave	11	TOP-ED - B Test	99	52.96%
Average - TOP-ED	50	Average - Test	108	61.97%
Sec 02 (MWF) Comb Ave	16	Trad - A Control	120	64.16%
Sec 05 (TTH) Segr Ave	7	Trad - B Control	148	70.56%
Average - Trad	23	Average - Control	134	67.36%

(Table Continues)

Table 1 Continued

A Comparison Table for Team Oriented Performance - Education (TOP-ED) at Embry-Riddle Aeronautical University in Arizona

A	B	C	D	E
Combined Averages for Fall 1996	No of Stu	Type of Study	Assign Senior Number	First 1/3 Grade (25%)
Sec 03 (MWF) N-Exp Ave	12	TOP-ED - B Test	100	57.92%
Sec 04 (MWF) N-Exp Ave	21	TOP-ED - A Test	119	73.72%
Sec 05 (TTH) N-Exp Ave	11	TOP-ED - B Test	99	52.96%
Average - N-Exp TOP-ED	44	Average - Test	106	61.53%
Sec 02 (MWF) N-Exp Ave	11	Trad - A Control	117	67.28%
Sec 05 (TTH) N-Exp Ave	4	Trad - B Control	123	72.96%
Average - N-Exp Trad	15	Average - Control	120	70.12%
Sec 04 (MWF) Exp - Ave	6	TOP-ED - A Test	181	80.04%
Sec 02 (MWF) Exp - Ave	5	Trad - A Control	181	79.12%
Sec 05 (TTH) Exp - Ave	3	Trad - B Control	193	67.92%
Average - Exp trad	8	Average - Control	187	73.52%

Table 2

A Comparison Table for Team Oriented Performance - Education (TOP-ED) at Embry-Riddle Aeronautical University in Arizona

A	F	G	H	I	J	K
Combined Averages for Fall 1996	Test 2 (12%)	Team Perfo (33%)	2/3s Grade (58%)	I-Fact 2/3s -1/3	T-Cont Total (25%)	Total Team (58%)
Sec 03 (MWF) Comb Ave	69.0	74.95	67.61	10	87.87	80.52
Sec 04 (MWF) Comb Ave	82.0	87.17	81.94	7	86.87	87.04
Sec 05 (TTH) Segr Ave	71.0	75.59	65.84	13	86.23	80.18
Average - TOP-ED	74.0	79.24	71.80	10	86.99	82.58
Sec 02 (MWF) Comb Ave	74.0	76.85	71.38	7	86.87	81.17
Sec 05 (TTH) Segr Ave	77.0	79.45	75.62	5	86.23	82.37
Average - Trad	75.5	78.15	73.50	6	86.55	81.77

(Table Continues)

Table 2 Continued

A Comparison Table for Team Oriented Performance - Education (TOP-ED) at Embry-Riddle Aeronautical University in Arizona

A	F	G	H	I	J	K
Combined Averages for Fall 1996	Test 2 (12%)	Team Perfo (33%)	2/3s Grade (58%)	I-Fact 2/3s -1/3	T-Cont Total (25%)	Total Team (58%)
Sec 03 (MWF) N-Exp Ave	69.0	74.95	67.61	10	87.87	80.52
Sec 04 (MWF) N-Exp Ave	86.0	88.63	82.20	8	86.80	87.84
Sec 05 (TTH) N-Exp Ave	71.0	75.59	65.84	13	86.23	80.18
Average - N-Exp TOP-ED	75.33	79.73	71.88	10	86.97	82.85
Sec 02 (MWF) N-Exp Ave	71.0	73.46	70.80	4	86.87	79.24
Sec 05 (TTH) N-Exp Ave	78.0	81.80	77.99	5	86.23	83.71
Average - N-Exp Trad	74.50	77.63	74.39	4	86.55	81.47
Sec 04 (MWF) Exp - Ave	82.0	87.32	84.18	4	87.13	87.24
Sec 02 (MWF) Exp - Ave	81.0	81.44	80.44	1	86.87	83.78
Sec 05 (TTH) Exp - Ave	76.0	76.55	72.83	5	86.23	80.73
Average - Exp trad	78.5	79.00	76.64	3	86.55	82.25

Table 3

A Comparison Table for Team Oriented Performance - Education (TOP-ED) at Embry-Riddle Aeronautical University in Arizona

A	L	M	N	O	P
Combined Averages for Fall 1996	Before Final (83%)	Final Raw (17%)	Course Overall (100%)	I-Fact Final -1st 1/3	I-Fact Course -1st 1/3
Sec 03 (MWF) Comb Ave	73.71	66.00	72.40	8.08	14.48
Sec 04 (MWF) Comb Ave	83.42	74.00	81.82	-1.04	6.78
Sec 05 (TTH) Segr Ave	71.98	66.00	70.96	13.04	18.00
Average - TOP-ED	76.37	68.67	75.06	6.69	13.09
Sec 02 (MWF) Comb Ave	76.04	75.00	75.87	10.84	11.71
Sec 05 (TTH) Segr Ave	78.81	82.00	79.36	11.44	8.80
Average - Trad	77.43	78.50	77.61	11.14	10.25

(Table Continues)

Table 3 Continued

A Comparison Table for Team Oriented Performance - Education (TOP-ED) at Embry-Riddle Aeronautical University in Arizona

A	L	M	N	O	P
Combined Averages for Fall 1996	Before Final (83%)	Final Raw (17%)	Course Overall (100%)	I-Fact Final -1st 1/3	I-Fact Course -1st 1/3
Sec 03 (MWF) N-Exp Ave	73.71	66.00	72.40	8.08	14.48
Sec 04 (MWF) N-Exp Ave	83.59	74.00	81.96	0.28	8.24
Sec 05 (TTH) N-Exp Ave	71.98	66.00	70.96	13.04	18.00
Average - N-Exp TOP-ED	76.43	68.67	75.11	7.13	13.57
Sec 02 (MWF) N-Exp Ave	75.64	73.00	75.19	5.72	7.91
Sec 05 (TTH) N-Exp Ave	80.47	81.00	80.56	8.04	7.60
Average - N-Exp Trad	78.05	77.00	77.88	6.88	7.76
Sec 04 (MWF) Exp - Ave	85.07	76.00	83.53	-4.09	3.49
Sec 02 (MWF) Exp - Ave	82.37	81.00	82.14	1.88	3.02
Sec 05 (TTH) Exp - Ave	76.87	82.00	77.74	14.08	9.82
Average - Exp trad	79.62	81.50	79.94	7.98	6.42