DRAFT 1

BROAD-BASED STUDENT LEARNING OUTCOMES: AN ASSUMED ASSESSMENT REALITY CHECK EXPERIENCE IN AVIATION

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ABSTRACT:

Broad based Student Learning Outcomes (SLO) are being used and are becoming commonplace as accreditation requirement processes. Assessment of these SLO's are then required to ensure the SLO's are being met by the education entity. The problem then becomes one of identifying valid assessment tools. When assumptions are made in education knowledge levels or even skill performance, assessment error can occur. In aviation we have specific knowledge and skill performance levels set by Federal Regulations. One of our assumptions was students that met or exceeded these established and measurable standards were then ready to met our SLO's. One such SLO states for example that: "Students will be highly skilled professional aviators who understand the national airspace system and can interface with all facets of the air traffic control system".

To our surprise our students did not meet this SLO. This shortcoming came to our attention when we put our students in the right seat (serving Co-Pilot duties) of our C90 and C525 university transportation aircraft. The transportation Captain's feedback related that the operational and performance level of the students was very low and did not meet basic standard expectations.

To address this training short fall, PPIL 416 Crew Resource Management course was designed using a Flight Training Device similar to the C525 jet where Line Orientation Flight Training scenarios were flown. The student knowledge and skill level was improved dramatically to the point that we do meet the SLO. Direct feedback from the employer or in this case a quasi employer where the student is actually performing the mission their education and training is designed for is a necessary element for validating broadly stated Student Learning Outcome's. This lesson should be applicable across disciplines.

INTRODUCTION:

The Aviation Department has identified student learning outcomes as part of our accreditation and assessment process. These are typical examples of the broad outcome statements made by all departments in our college and I would expect these are representative of most colleges across the nation.

1. Students will be highly skilled professional aviators who understand the national airspace system and can interface with all facets of the air traffic control system:

2. Students will demonstrate communication skills and apply these skills in the aviation environment:

3. Students will understand their responsibility to continue professional and personal development with an emphasis on diversity, ethics and teamwork:

4. Students will use appropriate aeronautical decision making based on meteorological conditions, human factors and safety:

Our department has made "logical" assumptions over the years by citing that because we meet higher standards than the Federal Aviation Administration places on completing pilot ratings under our Federal Aviation Regulation Part 141 certification standards, and because our graduates' employer feedback is usually positive, we have always stated that our students/graduates met the stated outcomes listed above.

It was only when we started a regular program of students flying in our transportation aircraft under the supervision of seasoned pilots flying the King Air and Citation Jet did we have direct feedback to access the actual training and skill level our students. Sample size for this study was N=41.

PROBLEM:

When our students flew transportation flights and performed in the national airspace system and interfaced with air traffic control, the Captain would have to "teach" the students basic communications and procedures. We initially responded to this short coming by designing a course similar to what a pilot would obtain as part of transition training at Flight Safety International. The C90A, C525 aircraft operation, performance, and systems course was required before students could fly in these transportation aircraft. The transportation caption's feedback now revealed a somewhat better outcome but still the students lacked basic communication skills and knowledge of how to operate in the high altitude environment. It seemed that all the "pieces" of skill and knowledge were perhaps there but confidence and application was still inadequate. Students obtain an Instrument rating but never use it in the air traffic control system. Many students in the FAR Part 141 training program receive very little reinforcement of the knowledge and skills learned after they obtain an Instrument rating. After a year these skills (single pilot oriented) start to fade. When single pilot skills are transferred to a multi-crew environment and coupled with weak Instrument skills leads to poor performance.

SOLUTION:

Collectively in the department we determined a needed for a course that put all the individual knowledge and skills together in an application environment. PPIL 416 Crew Resource Management was developed to serve this purpose. It is becoming a capstone course for our professional pilot program. Successful completion of the course is now a pre-requisite for flying Transportation aircraft. The course is designed with four scenarios that are flown by student crews in a flight training devise (FTD) that is configured closely to our C525 jet. The student crews fly a "simulator" aircraft in a Line Oriented Flight Training

environment where all Air Traffic Control functions are integrated into the flight real time. The student crews plan the route, calculate aircraft performance, file flight plans, and then fly the cross country flight. It is important that the SOP, checklists, callouts, procedures all comply with the flight operations of the transportation flight section.

METHODOLOGY:

Classroom review of the CRM skill groups are re-enforced by flying four scenario flights in a FTD jet. All transportation flight section procedures are followed. This includes flight planning, performance cards, V callouts, checklists, SOP and rule of thumb procedures. The scenarios are designed to build on the CRM skill groups. Red Flag areas are stressed and learned throughout the flights (see appendix A). The scenarios are run by the course instructor and video recorded by student crews not flying using a tri-mounted camcorder with remote microphone input (aircraft headsets). The recorded flight is given to the student flight crew at the end of the flight to be screened for CRM skill groups and red flags. The flight crew critique their flight using major events in the flight in reference to observable behaviors in these skill groups and red flags areas.

Discussion and interchange of ideas are made throughout the critique process. A typical two hour flight will take fifty minutes to critique. The instructor interjects critique comments more as emphasis or expansions of the student critique process. The grade for the flight is determined by comparison the student crew critique items with the instructor's notes on the flight. A perfect overlay match would represent a one hundred percent score. The flying skill performance is not graded but the non technical skill areas are, which include: briefing and communication, leadership and teamwork, decision making and planning, situational awareness, crew attitude and performance and evaluation, and automation and technology.

The experiential learning cycle, (Johnston, 1993) is essentially used. The student crews experience the flight and events as they progressed; they discuss options within their shell of influence and make decisions, which then leads to reflecting on the decisions made. Then at the end of the flight and through the critique phase generalizations are made, lessons learned are discussed and these experiences are then applied to future planning and practices, thus completing the loop back to experiencing the next flight. The final scenario is designed by student crews and flown by a different student crew. The design crew becomes the "CRM instructor" in that they run the scenario and evaluate the flight crew's critique.

In summary the course activities include: Reviewing competency standards and regulations, understanding learning styles and group dynamics, develop personal awareness, develop basic skills through case study examples, understanding the learning environment, and providing critique and feedback on the CRM behavior markers, skill groupings, and red flags observed within the LOS/LOFT scenarios. Appendix B provides an example of a flight scenario with instructor and student flight crew critiques.

Lessons learned:

1. Using a jet configured Flight Training Device with glass, HSI, Auto Pilot, GPS is necessary for realistic speed/time situation awareness and automation skills.

2. Prior to the first scenario flight: at least one hour in this FTD is necessary to learn check list use, startup procedures, callouts, power settings, auto pilot use and capture rates, GPS programming, take offs and landings.
3. Review CRM basics in class prior to the first scenario flight.
4. Assign two students as crew by computer random selection.
5. Each scenario is designed for specific CRM skill groupings using CAP737 and AC120-51E.
6. Four scenarios are flown at about two hours each with alternating Pilot and Co-Pilot duties. There is a very large learning curve on each scenario flown with performance improvements. Communication skill is positively correlated with performance.
7. Aircraft performance cards, flight plans, weather, NOTAM, are completed prior to scenario flights. Scenarios are designed to be flexible enough to be modified for the submitted flight plans. Use real experiences in the scenarios such as carrying passengers that have to be at a meeting and requires coordinating of ground transportation.
8. Use of transportation flight SOP, checklists, approach briefings, etc is a must.
9. Each scenario builds on previous learning. Crews tend to make the same mistakes (traps) therefore critiques are useful for all crews. Student self-critiques tend to be very critical.
10. Knowledge exams, textbook chapter quizzes, all support materials are posted online to provide class time for critiques, discussions, and scenario flights.

CONCLUSION AND RECOMMENDATION:

The learning curve in this process is very high. The students themselves comment on how they can “feel” and “see” themselves improve when critiquing their recorded flights. By the third scenario most if not all of the skill group areas and red flags listed in Appendix A have been experienced. The observable behavior markers are learned quickly and fewer “mistakes” are made in each scenario flown even when new CRM skill clusters are introduced. Communication skills are improved quite dramatically and thus performance. Teamwork is new to their training but is learned and applied very quickly.
In September 2006, Scott Nichols, our chief transportation Captain said it best, “Without the CRM training it took about three flights before the pilots were able to contribute anything to the workload. Now they are an asset on the first flight”.

The standard assessment criteria we use for broadly stated student learning outcomes such as: (1) “Students will be highly skilled professional aviators who understand the national airspace system and can interface with all facets of the air traffic control system, (2) “students will demonstrate communication skills and apply these skills in the aviation environment”, (3) “students will understand their responsibility to continue professional and personal development with an emphasis on diversity, ethics and teamwork”, and (4) “students will use appropriate aeronautical decision making based on meteorological conditions, human factors and safety”, may be flawed without direct application feedback. We for years made assumptions that Federal Aviation Regulation training standards although fragmental would come together once the student enters the work force. This assumption was not fully supported from our experience.

All student-training programs with broad SLO’s which use assessment extrapolations similar to the ones tested in this paper could to one degree or another be subject to the same

flawed way of thinking. Direct performance feedback from employers of graduates would help confirm training program pre-graduate assessment validity.

Appendix A

CRM Skill Grouping

	CAA	FAA
1.	Briefing and Communication	Effective Communications
2.	Leadership and Teamwork	Stress and Performance
3.	Situational Awareness	Situational Awareness
4.	Decision Making and Planning	Decision Making
5.	Crew Self Evaluation	Attitude and Crew Performance
6.	Automation and Technology	

Crew Performance Marker Clusters

1. Communications processes and decision behavior cluster
    a. Briefings
    b. Inquiry/ advocacy/ assertion
    c. Crew self-critique regarding decisions and actions
    d. Communications/ decisions
2. Team building and maintenance cluster
    a. Leadership Followership/ concern for tasks
    b. Interpersonal relationships/ group climate
3. Workload management and situational awareness cluster
    a. Preparation/ planning/ vigilance
    b. Workload distributed/ distractions avoided

When should “red flags” tell you something is wrong?

1. Incomplete communication
2. Ambiguity
3. Unresolved discrepancies
4. Use of undocumented procedures
5. Pre-occupation or fixation
6. No one flying the aircraft
7. No one looking
8. Confusion
9. Dilution of SOP
10. Violation of limits and regulations
11. Failure to meet targets

CLR Command Leadership Resource Management (United Airline)

Command

1. Captain’s authority: gather information, act on information
2. First Officer: provide the right information at the right time
3. Crew climate: open communication, stress management / fatigue
4. Crew training development: LOFT: critique / debrief flight, observable behavior

Leadership

1. Communication: good techniques and recognize barriers, feedback loop
2. Define the right problem: must define the problem accurately / correctly, single event or multiple event, immediate actions, prioritize and allocate
3. Decision making: Prioritize, critique decision making process, single event does happen but usually there are other clues establishing a chain of errors

Resource Management

1. Work load management: planning ahead (PPPPP)
2. Situational awareness: space and time, expectation of errors
3. Use of resources: getting relevant information, updating information; wx, pilot reports, NOTAMS, etc.

Appendix B

SLOF 2a Scenario v8

Set up: make sure airport identifier uses "K" KMHK, always click on "save aircraft reposition", set wind data click on each level and click on wind enable block.

1. Set winds, temperature and pressure data as per the METAR and wind aloft data (01075 -21 29.92). FP is for 2 pax 4 total.
2. Crew should use ASOS 119.075 prior to engine start for wind direction and METAR info. "Manhattan Municipal Airport automated weather observation 1555 Zulu wind 180 degrees at 17 kts, visibility 7 miles, sky clear, temperature 13, dewpoint 9, altimeter 30.08" . Set winds, temperature and pressure data. Use filed flight plan for information to issue the clearance. Clearance delivery: 127.35. Ground is 121.85. Look for point to enter the airway system on the flight plan; "K-State 81 is cleared to the Will Rogers World airport direct Judge J21 J23, climb and maintain 14K expect FL 280 10 minutes after departure, KCC 126.85, squawk 1426". Take off should be to the south on rwy 21. Taxi instructions will be "K-State 81 taxi to runway 21 via taxi way A". Tower frequency is 118.55
3. Tower "K-State 81is cleared for take off rwy 21…(after take off).contact KC center now 126.85"
4. Center responds with "K-State 81 squawk ident", "radar contact xxx miles south of Manhattan airport, climb and maintain 14K".
5. Half way to Salina VOR, fail left generator "K-State 81 change my freq 126.85".
6. Five minutes before or just past Wichita fail right generator. Either they will divert to "closest appropriate airport" (Wichita Mid Continent) as per 91xxx or they will elect to continue on. Looking for reporting the problem and if they declare and emergency or not. If choosing Wichita and asking for vectors or clearance to ICT give them " K-State 81 is cleared direct to the Wichita VOR, contact Wichita Approach now on 134.85", after their call to Approach…. Looking to see if they have ATIS 125.15 Read METAR for ICT or if not "K-State 81 this is Wichita Approach radar contact, current weather at Wichita is: (read from METAR) runway 19L and 19R in use, cleared present position direct to the Wichita VOR, descend and maintain 4100 feet, cleared for the ILS RWY 19R approach contact tower 118.2 procedure turn inbound, do your require assistance?" If asking for radar vectors to rwy19R.. give vectors to final approach course (or if emergency was declared "understand you are declaring an emergency, the crash trucks are standing by".
7. If radar vectors are asked for, give them radar vectors to the final approach course with a 30 degree intercept angle to the localizer "K-State turn right heading 160 degrees to intercept the localizer for the ILS 19R approach contact tower now 118.2".
8. "K-State 81 clear to land runway 19R do you require any assistance?"
9. "K-State 81 contact ground 121.9 when clear"

At this point you repair the alternator quick turnaround and file on to Will Rogers World.

10. Clearance delivery: "K-State 81 is cleared to Will Rogers World airport, Wichita J23 FL240 squawk 4136".
11. Ground: "K-State 81 taxi to runway 19R"

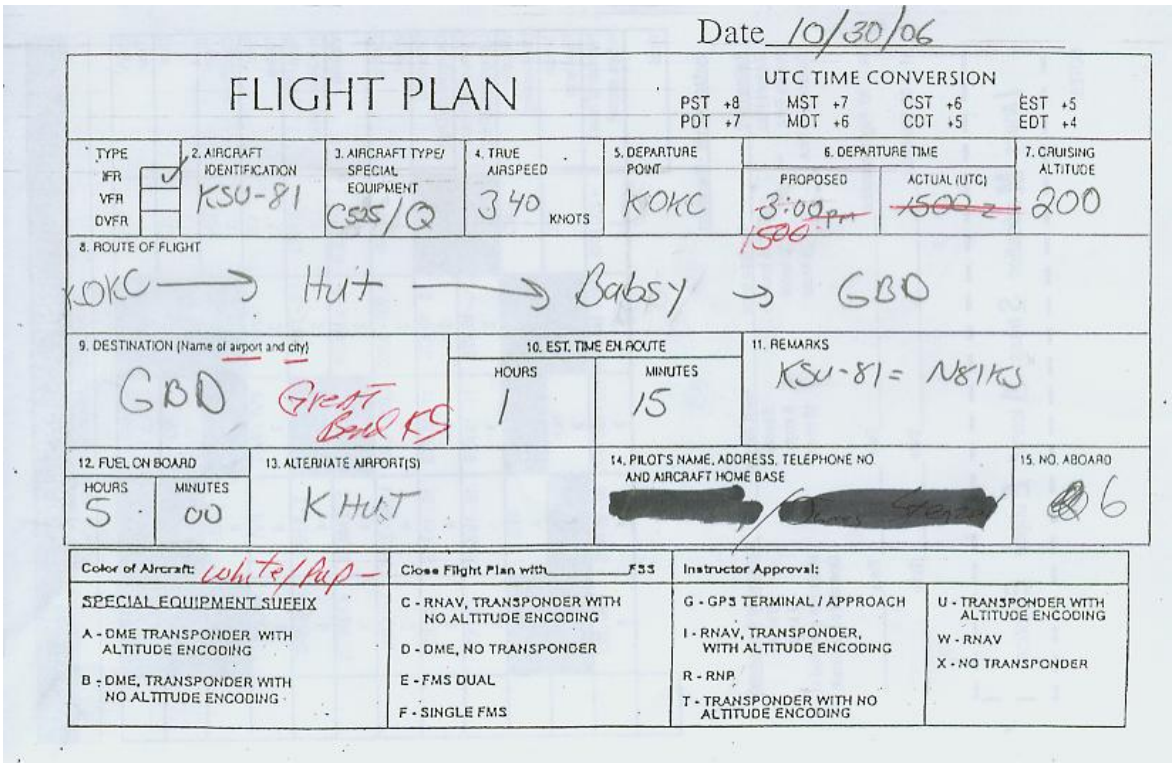
12. Tower: "K-State 81 is cleared for takeoff runway 19R"…. after TO "contact departure now 126.7 ".
13. Departure: "K-State 81 radar contact, climb and maintain 14K"
14. "K-State 81 contact Kansas City Center 126.85"
15. "K-State 81 radar contact"
16. "K-State 81 is cleared direct Pioneer cross Pioneer at 9000 feet.
17. After Pioneer, "K-State 81 descend and maintain 6000."
18. ATIS when dialed on 125.85 Read OKC METAR add "RWY 17 L and 17R in use Will Rogers World information E"
19. Before GULLI intersection: "K-State 81 contact Oklahoma City Approach now 124.6"
20. "K-State 81 radar contact, cleared for the Trump Five Arrival Will Rogers World airport, maintain 6000 until GULLI."
21. At TRUMP intersection: "K-State 81 turn right 217 degrees transition your own navigation to intercept the LOC you are cleared for the ILS RWY 17L approach Will Rogers."
22. At the intercept: "K-State 81 contact tower 119.35" ATREC inbound. (FILUM if 17R used)
23. "K-State 81 cleared to land RWY 17L"
24. "K-State 81 contact ground" ground freq; 121.9

New Captain new passengers (4pax, 6 on FP)

1. Start up, ATIS freq 125.85 Read METAR for OKC
2. Clearance delivery freq 124.35
3. "K-State 81 is cleared to the Great Bend airport, OKC, J21, IBAPE, V77 Pioneer V256, HUT, V132 Great Bend, climb maintain 17K, expect FLxxx 10 minutes after departure, squawk 4214; departure instructions turn left to heading 090 contact departure 120.45 climbing through 2K"
4. Routing to avoid A-562A and A-562B
5. Ground 121.9: "K-State 81 taxi to RWY 17L" (make sure "information" ie. "E" is given by crew)
6. Tower 119.35: "K-State 81 cleared for TO RWY 17L"
7. Departure 120.45: "K-State 81 radar contact (state altitude) turn left heading 010 climb and maintain 9K"
8. Vector them to J21, "K-State81 contact KCC now 126.85"
9. "K-State 81 radar contact cleared direct pioneer, climb and maintain FL xxx"
10. GBD weather (best if called through Kansas City Flight Watch 123.625) or received on Wichita Radio 122.5 or through Center **when asked,** or if close enough AWOS-3 on 119.275 (if AWOS: "Great Bend municipal airport automated weather observation, 1755 zulu") will be "Great Bend weather 1755Z 190/14 visibility ¾ (or give 1 mile then drop to ¾ as an update) , 700 broken 1200 overcast, temperature 10 dewpoint 9, altimeter 29.95" (wx has dropped to IFR and below the circling minimums of 1 sm) Decision has to be made to hold or shoot the approach… weather goes to ½ sm if they elect to hold. Landing with 14 kt tailwind exceeds limits of CJ.

11. They should discus the next landing point with their passengers ie. “we can’t get into Great Bend but Hutchinson and Salina look good… you could rent a car or get on at the Salina campus and drive to your meeting”….
12. Give clearance to Hutchinson, Salina, or Manhattan; now where else has acceptable weather. Do they discuss an alternate airport? Use weather at each of the other sites…. Read the METAR at ICT for both HUT and SLN current weather when asked.
13. If they ask for a clearance direct to Manhattan or Salina it will take them through R-3601A, R-3601B and Bison MOA which are active… “Direct ANTON direct MHK maintain 11K” squawk 4243 ident” and “radar contact” could be given. “K-State 81 contact KCC 134.9” north of ANTON “K-State 81 is cleared for the GPS RWY 21 approach at Manhattan weather 1855Z wind 180/18 visibility 1 sm 700 feet overcast temperature 10 dewpoint 8 altimeter 29.95 RWY 21 in use, contact tower 118.55 AGOKE in-bound.” Twr: “K-State 81 is cleared to land RWY 21. Gnd:“K-State 81 contact ground 121.85.”
14. If they choose to land at HUT, KCC 118.8; **Hand them the approach plates** “K-State 81 is cleared to the HUT VOR or give radar vectors if asked, the (HUT information D 1855Z if ATIS used) weather at HUT (if received by ICT approach) is wind 170 at 17, visibility 3 miles, 700 overcast, temperature 13, dewpoint 10, altimeter 30.10, ILS RWY 13 in use, maintain 7K contact Wichita Approach on 125.5” (they should be on 118.8 KCC) “K-State 81 this is Wichita Approach radar contact (give weather again if ‘information D’ is not identified on initial contact), cleared for the ILS RWY 13 approach descend and maintain 5K until HUT VOR contact tower 118.5 SALTT in-bound” Twr: “K-State 81 is cleared to land RWY 13” Gr: “K-State 81 contact ground” (121.9) ATIS 124.25 use WX above.
15. If they choose to land at SLN; **Hand them the approach plates** “K-State 81 is cleared to the Salina VOR maintain 5K contact KCC on 134.9” “K-State 81 what approach do you want at Salina? “K-State 81 is cleared for the (approach they ask for if it is ILS 35, VOR 17, or RNAV(GPS) 17), contact tower 119.3 (at FAF)” Twr:“K-State 81 is cleared to land RWY 17” if they use the ILS it will be “cleared to circle land RWY 17” the wind is 20kts out of the south so they should use RWY 17. Give ATIS 120.15 using ICT METAR information. Twr: “K-State 81 taxi to the K-State ramp monitor ground”

Student flight plan



Date 10/30/06

FLIGHT PLAN

UTC TIME CONVERSION

PST +8	MST +7	CST +6	EST +5
PDT +7	MDT +6	CDT +5	EDT +4

TYPE	2. AIRCRAFT IDENTIFICATION	3. AIRCRAFT TYPE/ SPECIAL EQUIPMENT	4. TRUE AIRSPEED	5. DEPARTURE POINT	6. DEPARTURE TIME		7. CRUISING ALTITUDE
IFR ✓	KSU-81	C525/Q	340 KNOTS	KOKC	PROPOSED 3:00 ~~pm~~ 1500	ACTUAL (UTC) ~~1500 Z~~	200
VFR							
DVFR							

8. ROUTE OF FLIGHT

KOKC → Hut → Babsy → GBD

9. DESTINATION (Name of airport and city)	10. EST. TIME EN ROUTE		11. REMARKS
	HOURS	MINUTES	
GBD Great Bend KS	1	15	KSU-81 = N81KS

12. FUEL ON BOARD		13. ALTERNATE AIRPORT(S)	14. PILOT'S NAME, ADDRESS, TELEPHONE NO AND AIRCRAFT HOME BASE	15. NO. ABOARD
HOURS	MINUTES			
5	00	K HUT	[redacted]	6

Color of Aircraft: white/Rup—

Close Flight Plan with _____ FSS

Instructor Approval:

SPECIAL EQUIPMENT SUFFIX

A - DME TRANSPONDER WITH ALTITUDE ENCODING

B - DME, TRANSPONDER WITH NO ALTITUDE ENCODING

C - RNAV, TRANSPONDER WITH NO ALTITUDE ENCODING

D - DME, NO TRANSPONDER

E - FMS DUAL

F - SINGLE FMS

G - GPS TERMINAL / APPROACH

I - RNAV, TRANSPONDER, WITH ALTITUDE ENCODING

R - RNP

T - TRANSPONDER WITH NO ALTITUDE ENCODING

U - TRANSPONDER WITH ALTITUDE ENCODING

W - RNAV

X - NO TRANSPONDER

Instructor notes

10/30/06
TEAM 4 [redacted] 3800
SC 3 3200
OKC to GBD

1. a little confusion on w direct + divert engine
2. call outs AS alive 8 missed 80 KTS
called V2 Rotate not 105 Rotate
3. missed "2 pos rate of climb" gear up
4. gear up @ 8000 ft (A)
5. always use radios + Nav — too much reliability on GPS only - no back up
6. flew through course - not recognize HSI LOC needle
7. M 3200 @ 3000
8. confusion on PT or Straight in
9. FO "need RT turn" confusion - "hold heading"
10. No time started
11. Gear flaps OK
12. No call to tower @ Salt
13. did make call but late
14. did not fly GS to landing too low
15. did not call G Flaps
16. cpt "power" CPT always controls power
17. "need to call to cancel IFR" not need
18. (A) not enough discussion on destination
could have held @ HLT lose Alt -
19. Rushed App -
CRM - No Auto pilot
Vref Speeds forgot
Rented car - overwhelming

Student critique sheet

[redacted]

Flight # 3

Time	Event	Red Flags	Skill Groups
12:00	Real slow on airspeed around 110 knots on climb out	Preoccupation or Fixation	Situational Awareness
14:40	Waited for a while to perform "After Takeoff Checklist" Gear still down and Flaps	Preoccupation or Fixation	Situational Awareness
19:25	Blew through Altitude 750 ft	Violation of Limits and Regulations	Situational Awareness
21:00	Lost 550 ft of Altitude due to Fixation	Violation of Limits and Regulations, Fixation	Situational Awareness
23:15	Finally Performed Cruise Checklist. We waited a while	Preoccupation or Fixation	Decision Making and Planning
25:35	Called Flight watch to get weather for Great Bend, Good Communication Skills		Briefing and Communication
26:50	200 ft low on altitude. Was low and high a few time during flight	Violation of Limits and Regulations	Situational Awareness
31:10	Decided a little early to go to Hutch. Not the best decision we could have made. We could have waited a little longer to make the decision.		Decision Making and Planning
38:00	We got a little fast over 250 knots	Preoccupation or Fixation	Situational Awareness
40:35	Wasn't paying attention and flew through localizer course	Preoccupation or Fixation	Situational Awareness
43:25	Confusion about doing a procedure turn or not	Confusion	Decision Making and Planning
46:45	Had field in sight, so we got real low on glide slope and a little off course		Situational Awareness

Flight Debrief Discussion

- Good Communication Skills
- Flight Speed indicated over 250 knots during a segment of flight
- Got low on glide slope
- Forgot approach brief and airspeed callouts
- Late on after takeoff checklist

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