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Application of a Skill Taxonomy in Aviation

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Introduction

Purpose: Propose a taxonomy for defining the construct ‘skill’ utilizing a human-information processing approach

Useful for developing guidance and training, as well as system design applications

Skill Taxonomy Dimensions

1. Automaticity	The result of a smooth, continuous act requiring little conscious thought
2. Goal-Oriented	Enacted to achieve a specific end-state and is not merely a random act
3. Permanence	Behavior should be of a relatively permanent nature, as opposed to transitory
4. Generalizability	Should transfer to novel, though related, situations
5. Proficiency	Must meet a specified, predetermined level of proficiency
6. Origin	The knowledge is acquired through training and practice

Methodology

Approach: Two separate Cognitive Task Analyses (CTA) were used to identify the key knowledge, skills, and abilities in the domains of:

- Unmanned Systems Maintenance Operations
- Virtual Reality Flight Training

Skills elicited from CTAs evaluated by Subject Matter Experts (SMEs)

SME feedback used to refine the preliminary taxonomy

Results

UNMANNED SYSTEMS MAINTENANCE OPERATIONS

Subject Matter Experts

UASMx-SME_01.

- U.S. Army UAS electronics technician and crew chief for five years
- General knowledge of several UAS platforms, both consumer and tactical
- UAS maintenance instructor

UASMx-SME_02.

- Trained with Textron as an aircraft operator, crew chief, and mission coordinator
- Practical and general knowledgebase of half a dozen UAS

UASMx-SME_03.

- Six year career with Textron as a mechanic and crew chief
- General knowledge of several UAS systems

CTA Results: Airframe Task Subject Area

Subtask: Performing a repair to a damaged fiberglass wing as part of an impact damage inspection.

Drawn from the CTA, the skills needed to implement the repair effectively are:

- Knowledge of basic machining processes
- Proper cleaning of the damage
- Skill-based techniques
  - core filling
  - fiber wet out
  - fiber placement
  - epoxy mixing

Taxonomy Validation Skill: Repair damaged fiberglass wing as part of an impact damage inspection

Dimension	SME Evaluations
1. Automaticity	***UASMX_SME_01***: Agreed; there may not be a procedure to follow, as many UAS lack a structural repair manual ***UASMX_SME_02***: Agreed ***UASMX_SME_03***: A mix of controlled and automatic behaviors
2. Goal-Oriented	***UASMX_SME_01***: Agreed ***UASMX_SME_02***: Agreed ***UASMX_SME_03***: Agreed
3. Permanence	***UASMX_SME_01***: Agreed ***UASMX_SME_02***: Agreed ***UASMX_SME_03***: Agreed
4. Generalizability	***UASMX_SME_01***: Agreed ***UASMX_SME_02***: Agreed ***UASMX_SME_03***: Agreed
5. Proficiency	***UASMX_SME_01***: Agreed ***UASMX_SME_02***: Agreed ***UASMX_SME_03***: Agreed
6. Origin	***UASMX_SME_01***: Agreed ***UASMX_SME_02***: Agreed ***UASMX_SME_03***: Agreed

CTA Results: Powerplant Task Subject Area

Subtask: Removing and replacing a UAS engine due to a manufacturer life limit

Drawn from the CTA, the skills needed to implement the repair effectively are:

- Installing a small two-stroke gas engine
  - Knowledge and skills required:
    - Tooling identification
    - Tooling use
    - Engine systems
    - The ability to adequately comprehend given instructions and follow steps for proper installation
    - Basic understanding of torque and how it relates to fainters

Taxonomy Validation Subtask: Small two-stroke gas engine installation

Dimension	SME Evaluations
1. Automaticity	***UASMX_SME_01***: Agreed ***UASMX_SME_02***: Agreed; mix of automatic and controlled based on the difficulty of the task ***UASMX_SME_03***: Agreed; mix of automatic and controlled processes
2. Goal-Oriented	***UASMX_SME_01***: Agreed, but the standard should be to always follow the manual ***UASMX_SME_02***: Agreed ***UASMX_SME_03***: Agreed
3. Permanence	***UASMX_SME_01***: Agreed ***UASMX_SME_02***: Agreed ***UASMX_SME_03***: Agreed
4. Generalizability	***UASMX_SME_01***: Agreed ***UASMX_SME_02***: Agreed ***UASMX_SME_03***: Agreed
5. Proficiency	***UASMX_SME_01***: Agreed ***UASMX_SME_02***: Agreed ***UASMX_SME_03***: Agreed
6. Origin	***UASMX_SME_01***: Agreed ***UASMX_SME_02***: Agreed ***UASMX_SME_03***: Agreed

Results

VIRTUAL REALITY PART TASK TRAINER FOR AIRBORNE REFUELING

Subject Matter Expert

Retired from the United States Marine Corps

Eight years of flight experience

Five years spent flying F-18 Hornets

750 hours of tactical flight time

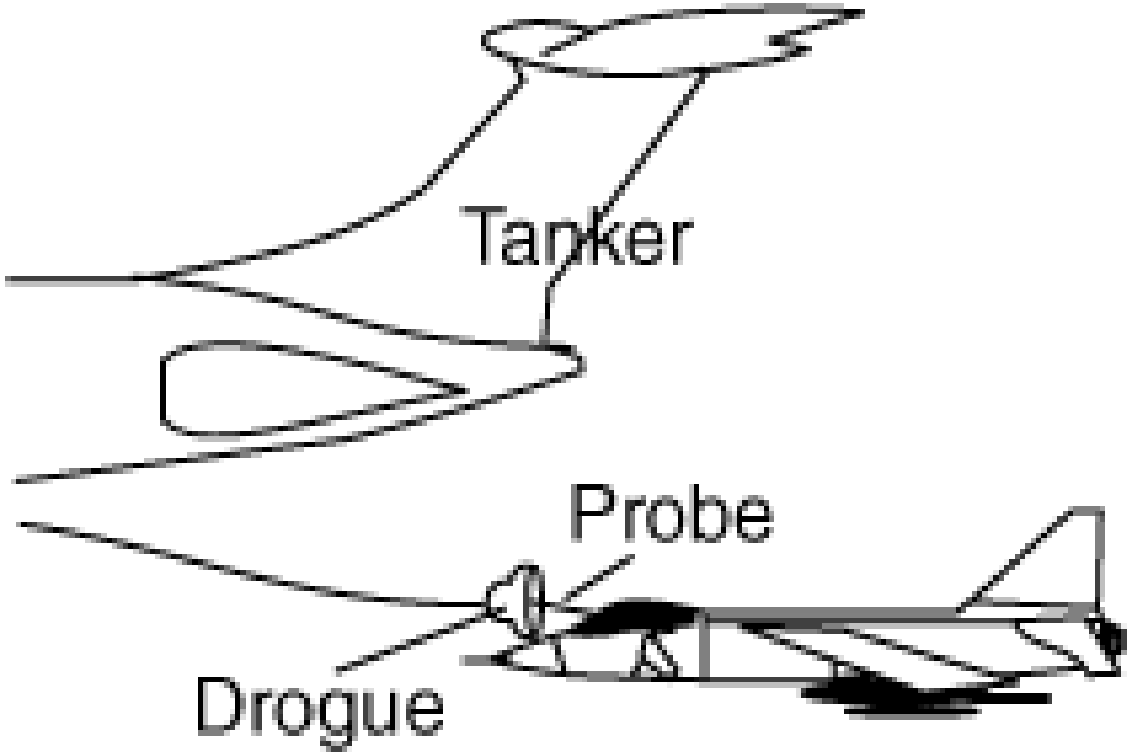
Performed the F-18 Virtual Reality Validation Trial for Embry-Riddle Aeronautical University

CTA Results: Virtual Reality Part Task Trainer for Airborne Refueling

Subtask: F18 pilot guides probe into drogue to refuel

Knowledge, skills, and abilities required to complete the subtask:

- "Dancing on the controls"
- Formation flying



Aviation Dictionary. (2014). Probe and Drogue. *Academic Dictionaries and Encyclopedias*. Retrieved from http://aviation_dictionary.enacademic.com /5339/probe_and_drogue

Taxonomy Validation
Skill: “Dancing on the Controls”

Dimension	SME Evaluation
1. Automaticity	Agreed
2. Goal-Oriented	Agreed
3. Permanence	Agreed
4. Generalizability	Agreed
5. Proficiency	Agreed
6. Origin	Agreed; transferred skill from formation flight training

Taxonomy Validation
Skill: Formation Flying

Dimension	SME Evaluation
1. Automaticity	Agreed
2. Goal-Oriented	Agreed
3. Permanence	Agreed
4. Generalizability	Agreed
5. Proficiency	Agreed
6. Origin	Agreed

Discussion

- SMEs confirmed that skills met all six dimensions in both domains
- Results from this initial study show promise for the skill taxonomy
- Taxonomy was able to capture targeted skills of the six dimensions

Next Steps

- Additional domain: Commercial Aviation

Questions?