National Training Aircraft Symposium (NTAS)

2017 - Training Pilots of the Future: Techniques & Technology

Aug 14th, 1:15 PM - 2:45 PM

Adaptive Learning Pedagogy in UDL and Multi-Modal Training

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14 August 2017

Adaptive Learning Pedagogy for Universal Design for Learning and Multi-Modal Training

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Introduction

- FAA has been searching for effective ways to train a large number of ATCSs.

- In general, traditional ways of teaching provide information using a fixed format, preventing customization based on each trainee's needs, or being unable to provide multiple means of engagement to address diversified needs of the trainees.

- Examples:
  - A trainee identified as an "average" student might show similar performances whether information is provided visually or verbally.
  - Some might excel when the majority of information is provided visually.
  - Some might excel when the majority of information is provided verbally.

Introduction: UDL

- **Universal Design for Learning**: provides as many diversified teaching methods as possible based on three classifications (Hall, Meyer, & Rose, 2012; Dean, Lee-Post, & Hapke, 2017; Rose and Meyer, 2002).

Information Representation and comprehension ("what"): Perception, Expression, Symbols

Action and Expression ("how"): Expression and Communication

Engagement ("why"): Recruiting Interest, Sustaining Effort and Persistence,Self-Regulation

Introduction: Issues

- ***Issues of adapting UDL for training ATCSs***:

  - Such diversified materials takes much time and effort to develop.

  - Students go through intensive training within a limited time and the instructors have limited time to teach materials.

- ***One way to address the issues***: Investigate students' preferred learning styles.

  Details: There might be some dominant preferred learning styles of the trainees; therefore, we could develop several important teaching methods to achieve maximum effectiveness given the limited resources.

Introduction – Learning Styles

- Felder-Silverman Model (Felder and Silverman, 1988)

Preferred learning style		
Categorization	**Levels**	
Processing	Active	Prefer active experimentation or discussions
	Reflective	Thoroughly think about the processes
Perception	Sensory	Prefer data and facts (practical applications)
	Intuitive	Prefer theories and concepts
Input	Visual	Prefer pictures, images, and demonstrations
	Auditory	Prefer written or spoken explanations
Understanding	Sequential	Prefer following logical steps
	Global	Prefer grasping the whole picture

- Index for Learning Styles
  - 44 question survey to assess learning preferences (Felder and Soloman, 2000)

Introduction – Index for Learning Styles (ILS)

Sample question		**Classification**
I understand something	a) try it out	Active
better after I	b) think it through	Reflective
I prefer to study	a) in a group	Active
	b) alone	Reflective
If I were a teacher, I would	a) that deals with facts and real life situations	Sensing
rather teach a course	b) that deals with ideas or theories	Intuitive
In reading nonfiction, I	a) something that teaches me new facts or tells me	Sensing
prefer	how to do something	
	b) something that gives me new ideas to think about	Intuitive

Introduction – Index for Learning Styles (ILS)

Sample question		Classification
When I think about what I did yesterday, I am most likely to get	a) a picture b) words	Visual Verbal
When I get directions to a new place, I prefer	a) a map b) written or verbal directions	Visual Verbal
It is more important to me that an instructor	a) lay out material in clear sequential steps b) give me an overall picture and relate materials to other subjects	Sequential Global
When I solve problems	a) I usually work my way to the solutions one step at a time b) I often just see the solutions but then have to struggle to figure out the steps to get to them	Sequential Global

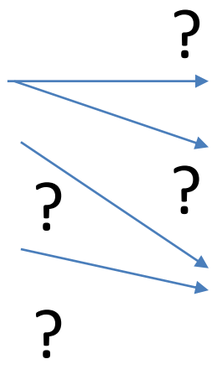
Introduction: Issue of using ILS

- ***Issue of using learning styles to develop UDL methods.***

  - There is no mapping process.

Which maps with which?

UDL:
Information representation and comprehension
Action and expression
Engagement



Learning styles:
Processing
Perception
Input
Understanding

Proposed method

1. **Map learning styles with UDL methods.**

2. **Develop adapted UDL implement procedure to address the issues of limited resources.**

1. Proposed mapping approach

UDL	Learning styles	Mapping of UDL and learning styles through practical scaffolding implementations
1.1. Provide options of customize the display of information	(ALL) All types	ALL.1.1.1. Provide options to change the size or contrast of text, figures, graphs, or tables. ALL.1.1.2. Provide options to highlight information for emphasis. ALL.1.1.3. Provide video or audio recordings that allows options (e.g. change speed or volume, toggle caption).
1.2. Offer alternatives to visual information (e.g. figures, graphs)	(VER) Verbal	VER.1.2.1. Provide auditory and text descriptions. VER.1.2.2. Provide auditory queues for key concepts. VER.1.2.3. provide text-to-speech software. VER.1.2.4. provide audio clips as needed.

Segment of proposed mapping of UDL principle 1 (Information Representation)

1. Proposed mapping approach

UDL	Learning styles	Mapping of UDL and learning styles through practical scaffolding implementations
1.3. Offer alternatives to auditory information	(VIS) Visual learners	VIS.1.3.1. Provide additional visual guidance as a scaffold if only verbal guidance is provided. VIS.1.3.2. Provide captions. VIS.1.3.3. Provide speech-to-text software. VIS.1.3.4. Provide video clips as needed.
1.4. Provide scaffolding options for comprehending vocabulary or symbols	(ALL) All types	ALL.1.4.1. Connect vocabulary or symbols that promote connection to previous experience or knowledge. ALL.1.4.2. Highlight how complex vocabulary can be composed of simpler words. ALL.1.4.3. Embed hyperlinks, footnotes, or illustrations to further explain vocabulary or symbols.

1. Proposed mapping approach

UDL	Learning styles	Mapping of UDL and learning styles through practical scaffolding implementations
1.5. Provide scaffolding options for comprehending key concepts	(ALL) All types	ALL.1.5.1. Show explicit links among the slides, text, and lab sessions (e.g. if a slide is from a text book, then show the narrowed range of the page numbers) ALL.1.5.2. Use analogy and metaphors as needed.
	(ACT) Active learners	ACT.1.5.3. Provide lectures that include problem-solving activities (pprox.. 5 minutes or less per activity). ACT.1.5.4. Provide material links of real life examples.
	(REF) Reflective learners	REF.1.5.5. Provide occasional pause during lectures and lab sessions. REF.1.5.6. Provide material links that emphasize fundamental understanding,
	(SEN) Sensing learners	SEN.1.5.7. Provide links to facts, data, and observable phenomena. SEN.1.5.8. Provide material links that emphasize specific examples.
	(INT) Intuitive learners	INT.1.5.9. Show the relationships and associated interpretations among the concepts, procedures, and theories.
	(SEQ) Sequential learners	SEQ.1.5.10. Give explicit prompts (or cues) for each step in a sequential process. SEQ.1.5.11. Provide options to change the organization and layout of the class contents. SEQ.1.5.12. Progressively release information (a.k.a sequential highlighting).
	(GLO) Global learners	GLO.1.5.13. Provide options to connect the new class contents with the contents that the students already know. GLO.1.5.14. Provide opportunities to synthesize concepts (e.g. expose them with advanced concepts before the concepts would normally be introduced). GLO.1.5.15. Provide "What-if" questions.

1. Proposed mapping approach

UDL method details	Learning styles	Mapping of UDL and learning styles through practical scaffolding implementations
2.1. Provide multiple media for communication	(ALL) All types	ALL.2.1.1. Provide interactive online tools embedded within the teaching materials for effective communication between the instructors and students. ALL.2.1.2. Provide exercises that allow alternative problem solution procedures or actions. ALL.2.1.3. Show progress representations and prompt learners to identify the feedback or advice that they are seeking. ALL.2.1.4. Provide interactive checklists/rubrics and links to multiple examples of how students acted and expressed correct answers.

1. Proposed mapping approach

UDL method details	Learning styles	Mapping of UDL and learning styles through practical scaffolding implementations
2.2. Provide alternative ways to express themselves	(ACT) Active learners	ACT.2.2.1. Provide options to create a study group: Members can take turns explaining different concepts to foster discussion or take turns asking/answering questions. ACT.2.2.2. Provide hands on experience examples.
	(REF) Reflective learners	REF.2.2.3. Allow some time to the students to write their own short summaries of the slides, textbooks, and lab session materials.
	(SEN) Sensing learners	SEN.2.2.4. Allow the students to request more examples: Provide free access to the additional examples not explained to them during time limited lectures or lab sessions.
	(INT) Intuitive learners	INT.2.2.5. Allow the students to request additional interpretations of, and relationships among, the concepts, procedures, and theories.
	(VIS) Visual learners	VIS.2.2.6. Provide an opportunity to foster visual imagery (as an intermediate step) before they provide answers or execute actions.
	(VER) Verbal learners	VER.2.2.7. Provide an opportunity to apply the think-aloud method or to paraphrase the procedures (as an intermediate step) before they answer or execute actions.
	(SEQ) Sequential learners	SEQ.2.2.8. Provide feedback through having them express their logical steps or critical thinking processes.
	(GLO) Global learners	GLO.2.2.9. Let the students first devise their own methods for solving problems rather than forcing the instructor's strategy.

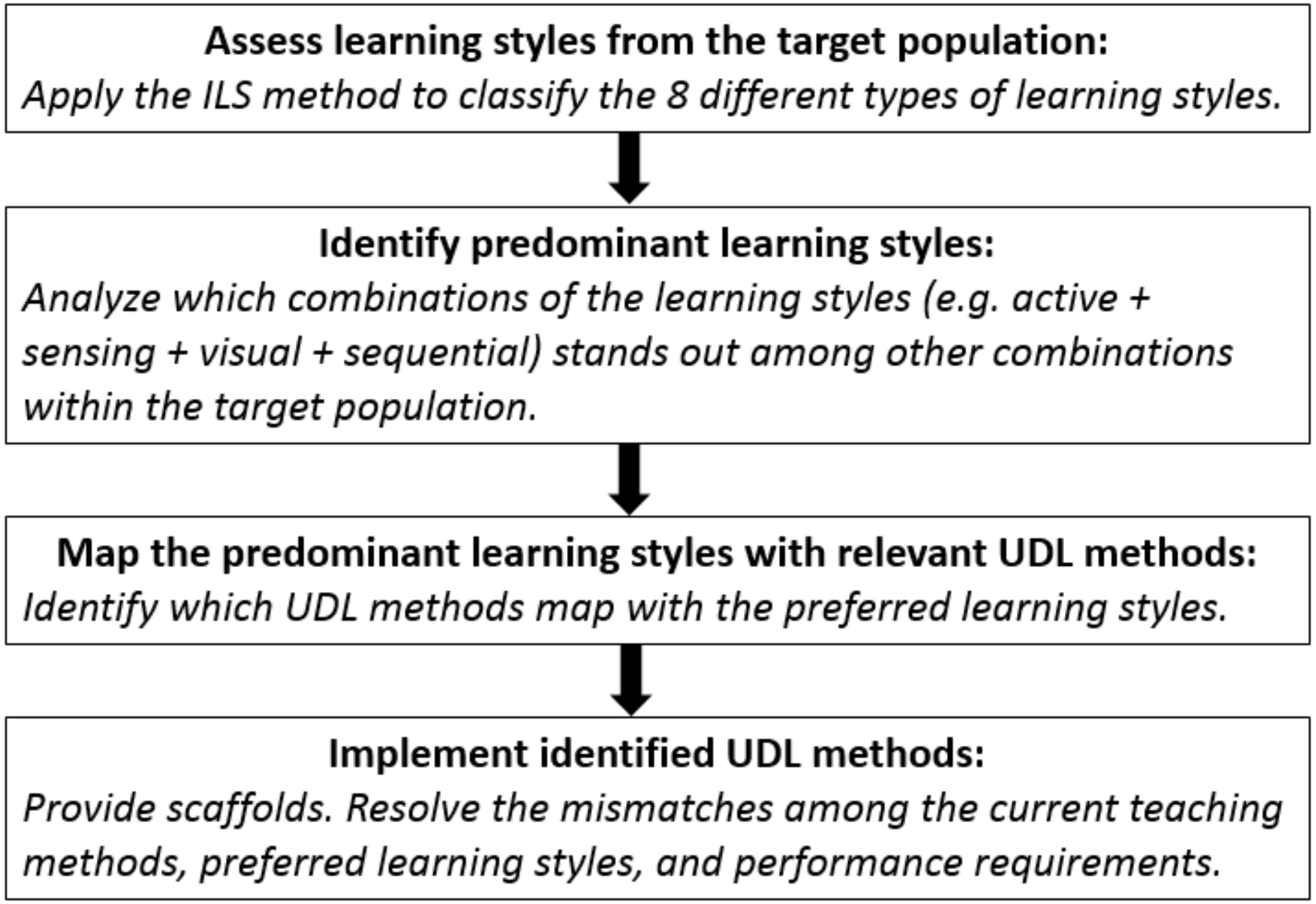
1. Proposed mapping approach

3.1. Provide options for recruiting interest	3.1.1. Provide what challenges are to be expected and what are the types of awards or recognitions available per area and/or topic. 3.1.2. Provide checklists, sticky notes, and electronic reminders for them to follow up during the training process. 3.1.3. Allow the students to create their own expectations and necessary activities. 3.1.4. Provide tasks that require active participation, exploration, and experimentation. Passive learning does not help any learning styles. 3.1.5. Encourage division of long-term goals into short-term objectives. 3.1.6. Demonstrate the use of available technology and information access/customization methods.
	3.1.7. Vary the levels of novelty or risk. 3.1.8. Vary the levels of sensory stimulation. 3.1.9. Vary the degrees of freedom for acceptable performance. 3.1.10. Address language barriers and cultural differences.

1. Proposed mapping approach

3.2. Provide options for sustaining effort and persistence.	3.2.1. Provide frequent, timely, and specific feedback with emphasis on identification of patterns of errors, efforts, and improvements rather than relative performance. 3.2.2. Provide self-regulatory prompts, guidelines, rubrics, checklists to reduce stress and aggressive actions in response to frustration. 3.2.3. Provide feedback on strengths and weaknesses.
3.3. Provide options for self-regulation	3.3.1. Provide scaffolds or feedback to the students so that they can seek emotional support, cope with schedules, and apply natural aptitudes (e.g. having them think "how can I improve on this topic?" rather than "I'm not good at this topic") 3.3.2. Provide scaffolds so that the students can monitor their own progress (e.g. charts, feedback notes). 3.3.3. Create school-wide programs to support positive behaviors.

2. Proposed Implementation Approach

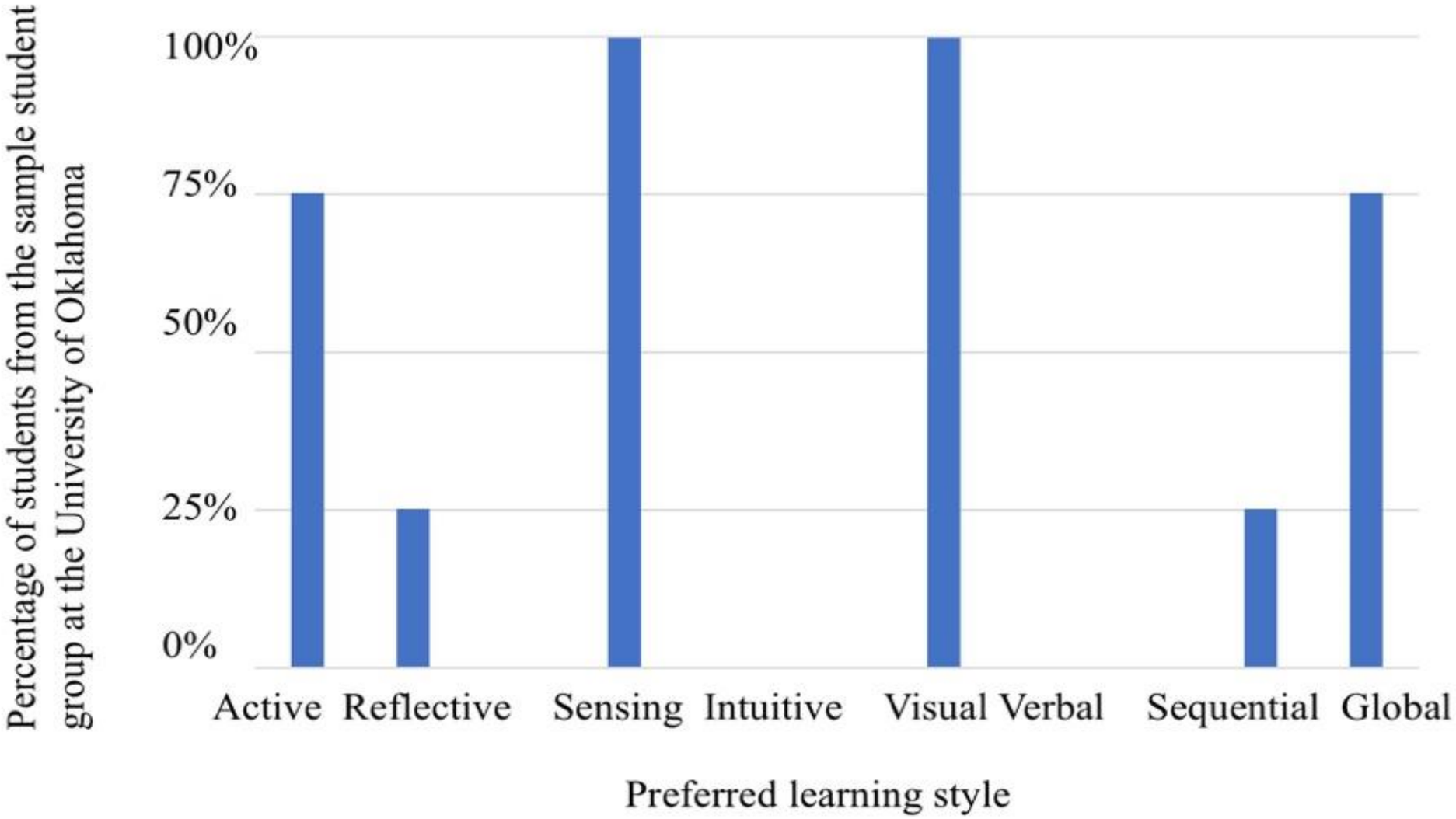


Note: Apply other less predominant learning styles if time and resources are available.

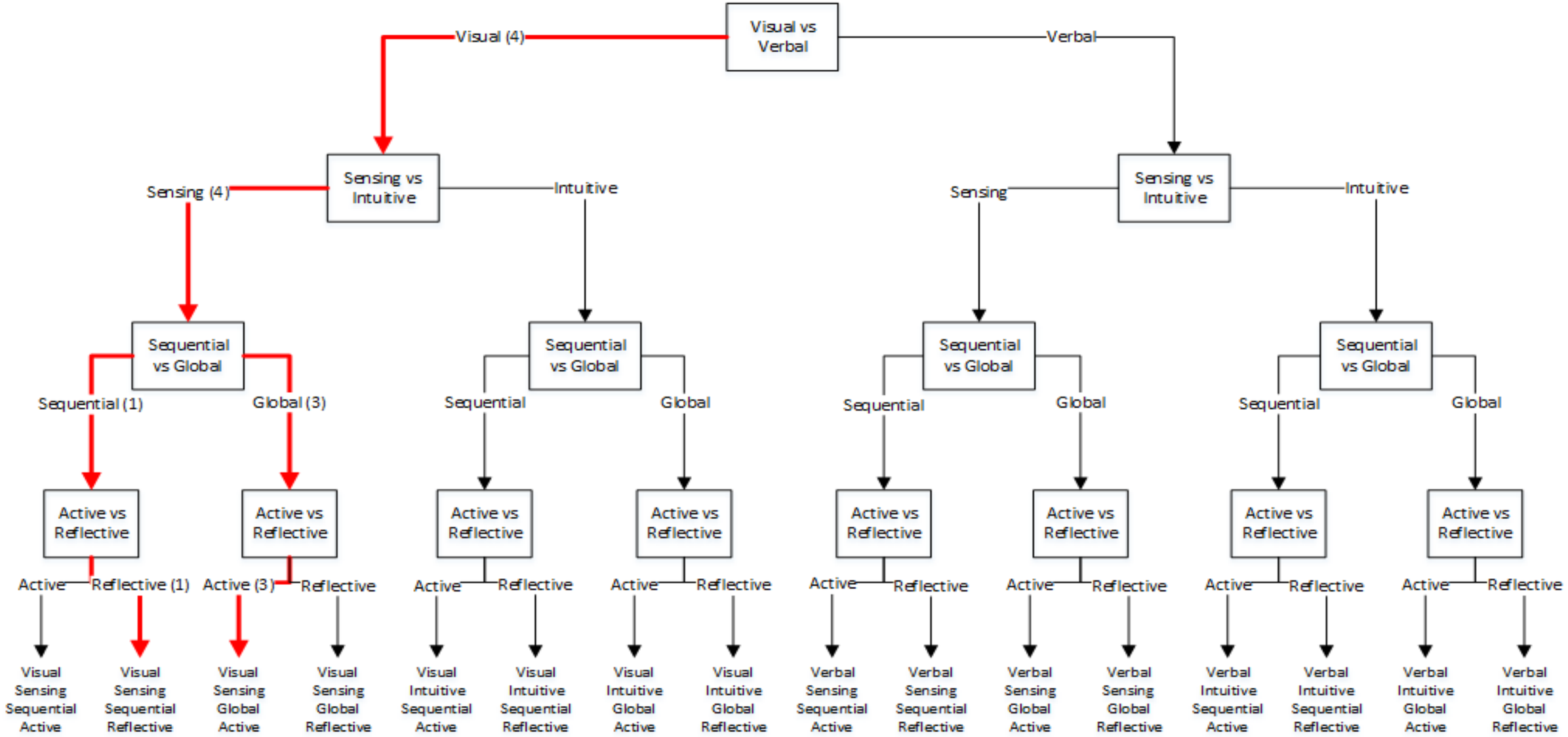
Case Study

- University of Oklahoma Aviation Laboratory
- Goal:
  - Verify effectiveness of proposed approaches
  - Identify methods to better train ATC candidates
- Learning style assessment
- Participations of 4 qualified students and 2 instructors

Case Study Results



Case Study Results



Case Study Results

- We can determine that there are two distinctive preferred learning styles:

  (1)Type VSSR: Visual+Sensing+Sequential+Reflective

  (2)Type VSGA: Visual+Sensing+Global+Active.

- Using Tables 1 and 2, the mapped UDL implementation examples are:

  (1) Type VSSR: VIS.1.3.1.-1.3.4., VIS.2.2.6., SEN.1.5.7.-1.5.8., SEN.2.2.4., SEQ.1.5.10-1.5.12., SEQ.2.2.8., REF.1.5.5-1.5.6., REF.2.2.3.

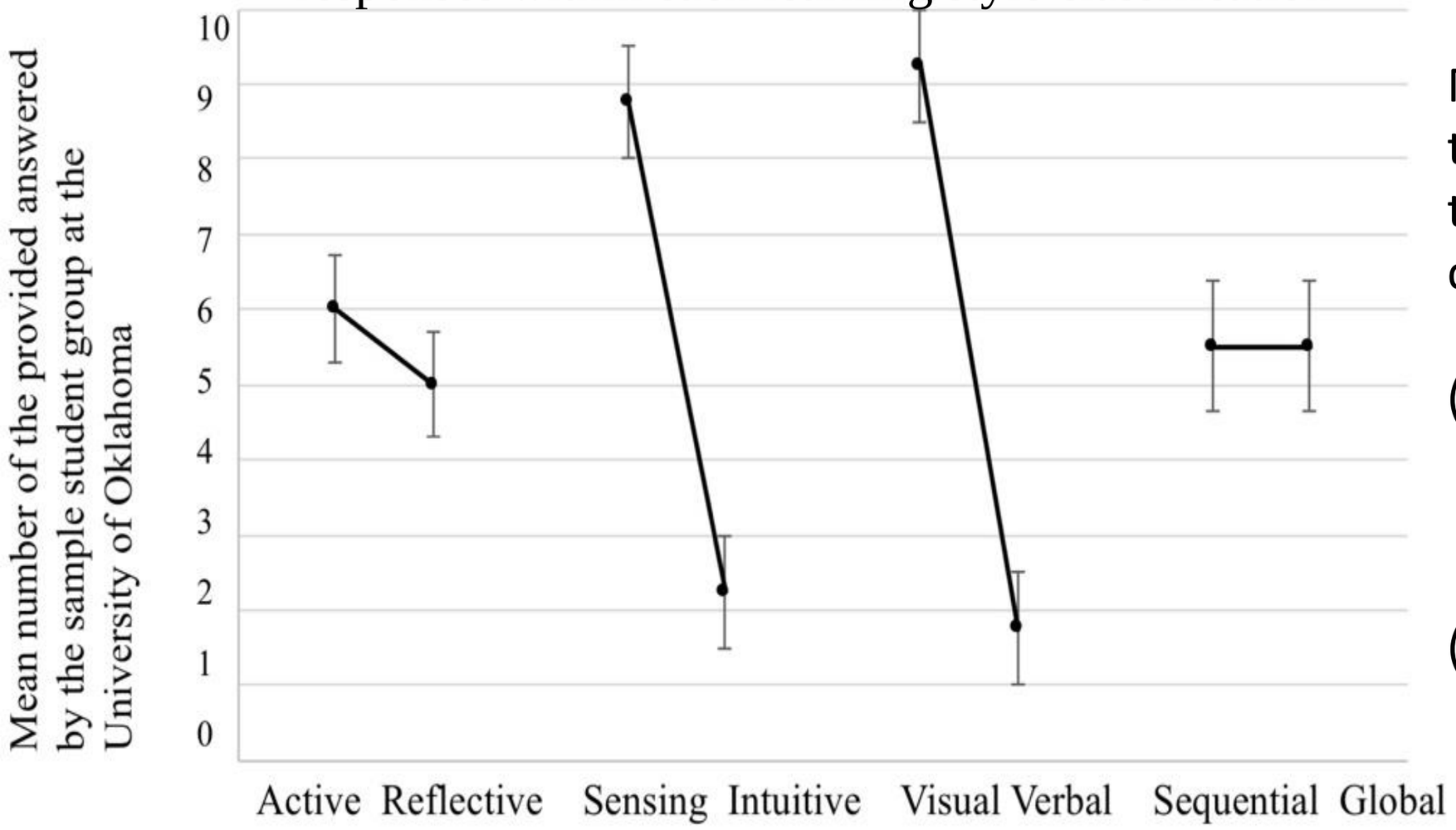
  (1)Type VSGA: VIS.1.3.1-1.3.4., VIS.2.2.6., SEN.1.5.7.-1.5.8., SEN.2.2.4., ACT.1.5.3-1.5.4., ACT.2.2.1.-2.2.2., GLO.1.5.13-1.5.15 GLO.2.2.9.

Case Study Results

- However, it seemed that we can further reduce the necessary ULD implementation examples through the statistical analysis of the tallied numbers of overall responses within each learning style classification rather than just counting the numbers of classified students.

Case Study Results

Statistical analysis of the tallied number of responses within each learning style classification



Mann-Whitney tests revealed that there were substantial differences in

(1) Sensing vs Intuitive

and

(2) Visual vs. Verbal

Case Study Results

Final results obtain from the OU Aviation students:

Support sensing and visual learners:

Apply VIS.1.3.1-1.3.4., VIS.2.2.6., SEN.1.5.7.-1.5.8., and SEN.2.2.4.

Discussion

- Proposed mapping of learning styles and UDL methods and the implementation processes enabled us to identify the highest priorities that should be applied to effectively increase performance given the limited resources.

- The case study showed that the current OU Aviation senior students could benefit more through providing scaffolds aimed for visual and sensing learners.

  E.g. For the current OU Aviation senior students, provide visual tool(s) during lab sessions if the students struggle when communicating verbally. Then, remove the scaffolds as the students become more accustomed to the verbal communication environment.

Contributions

- Developed specific mapping approach between the learning styles and UDL methods that leaves out vagueness.

- Proposed implementing approach to first address the needs of the dominant learning tendencies of a student group that can be later be applied to different of larger student population.

- Validated the capabilities of the adapted approaches.

Limitations and Future Research

Limitations

- Outcomes support only the needs of the participants within the case study, and should not be used to generalize the complete student population.

Future Research

- Currently identifying other available implementation examples as possible.
- Currently trying to implement the examples into actual teaching materials.
- Currently assessing learning styles from the FAA Academy trainees.
- Look into applications of new technology:
  - Augmented reality, Virtual reality, and Apps

Contact Information

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