



Team Tutoring in the Generalized Intelligent Framework for Tutoring: Current and Future Directions

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GIFTSym5

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- The Generalized Intelligent Framework for Tutoring (GIFT) has been in active development for individual learners
- A goal is to be able to train multiple individuals or a Squad as part of a team tutor.
- Effort has begun to scale GIFT to be able to engage in team tutoring.



U.S. ARMY
RDECOM

Challenges to Team Tutoring **ARL**



- Technological
- Theoretical Methods to Support Team Tutoring
- Authoring Challenges



- Technological
 - Synchronizing computers
 - Passing messages between learners
 - Assessing learners and providing feedback

- Efforts:
 - Surveillance Tutor with Iowa State University
 - Demonstrated – 2 players working simultaneously; assessed by GIFT



- Theoretical Methods to Support Team Tutoring
 - Identifying a theoretical background to guide authoring tools and team tutoring functionality
 - Supporting different theoretically sound assessment methods
- Efforts: Team Meta-Analysis with Institute for Simulation and Training
 - Meta-Analysis of relevant articles from 2003 to 2013
 - Identification of contributors to Team Performance, Team Learning, Team Satisfaction, and Team Viability
 - Identification of Behavioral Markers for Teams



- Authoring Challenges
 - Construction of team authoring tools
 - Flexibility to support different types of team configurations
- Efforts:
 - Team authoring tools have not yet been implemented
 - Leveraging current DKF tools to create multiple DKFs (1 for each team member, and one overall team DKF)



- Meta-Analysis
 - Identified specific constructs that we need to be aware of when developing team tutoring tools/methods in GIFT
 - 300 articles that met criteria
- Searched for articles with keywords paired with team/unit/group/squad or crew that included:
 - performance, competency, trust, cognition, affect, communication, intelligent tutoring, virtual human, mood, skill, knowledge, ability...
- Divided into 4 areas:
 - Team Performance
 - Team Learning
 - Team Satisfaction
 - Team Viability

From Sottolare, R.A., Burke, C.S., Salas, E., Sinatra, A.M., Johnston, J.H., & Gilbert, S.B. (in press). Designing adaptive instruction for teams: A Meta-Analysis. *International Journal of Artificial Intelligence in Education*.



- Behavioral Markers

- Examples:

- Trust Marker: “Frequency which team members remind each other to follow through on their tasks (reverse coded)”
- Task Cohesion Marker: “Members are actively working together and pitch in to reach team goals”
- Team Communication Markers: “Team member communication is concise”, “Team member communication is timely”
- Team Collective Efficacy Marker: “Team members expressed confidence that they could efficiently resolve conflicts regarding which tasks to prioritize and complete the task and begin working toward this goal”

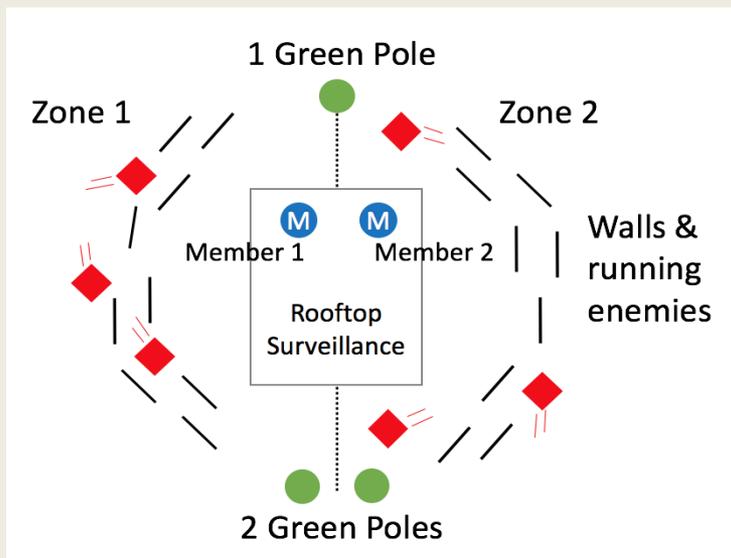
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- Future work:
 - Operationalizing the behavioral markers so they can be assessed in real-time during an ITS
 - Removing the human coder from the requirement
 - Implementing approaches so that authors can select the markers that they want to measure, and how they want to assess them

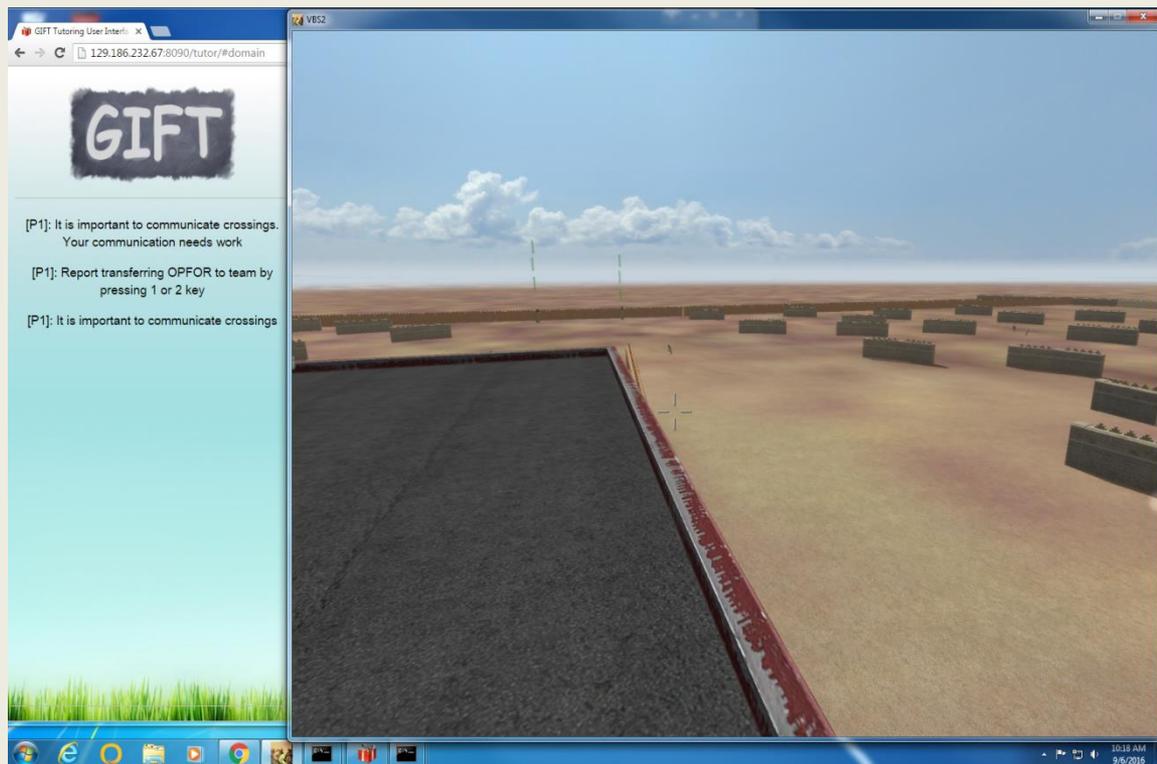


• Surveillance Task (Study 1, 2 learners)



Assessments:

Identify (Individual)
 Transfer (Individual)
 Acknowledge (Individual)
 Transfer-Acknowledge (Team)





Examples of Evaluations for Surveillance Task

Individual Transfer Task:

Transfer Action Assessment	Transfer Performance State Assessment	Individual Feedback to Members
Above-Expectation: N/A (task was binary)	Above-Expectation: Transfer occurred when OPFOR is at zone boundary	Good alerts about crossings.
At-Expectation: Transfer is announced for a crossing OPFOR.	At-Expectation: Transfer occurred shortly before OPFOR arrives at zone boundary	It is important to communicate crossings.
Below-Expectation: Transfer is not announced for a crossing OPFOR.	Below-Expectation: OPFOR passes into other team member's zone without a transfer occurring.	1 st : Make sure your partner always knows when an OPFOR is about to cross. 2 nd +: It is important report crossing OPFOR.

Team Transfer-Acknowledge Task:

Transfer-Acknowledge Team Action Assessment	Transfer-Acknowledge Team Performance State Assessment	Team Feedback to All Members
Above-Expectation: N/A (task was binary)	Above-Expectation: acknowledge time – transfer time ≤ 1 second	Successful handoffs!
At-Expectation: For the last transfer from either member, there was an acknowledge from the other member.	At-Expectation: acknowledge time – transfer time ≤ 2 seconds and > 1 second	It is important to alert each other about crossings and acknowledge them.
Below-Expectation: For the last transfer, there was no acknowledge.	Below-Expectation: acknowledge time – transfer time > 2 seconds	1 st : Your team communication needs to improve. 2 nd : Team, please keep up the communication. 3 rd +: Work on communication.

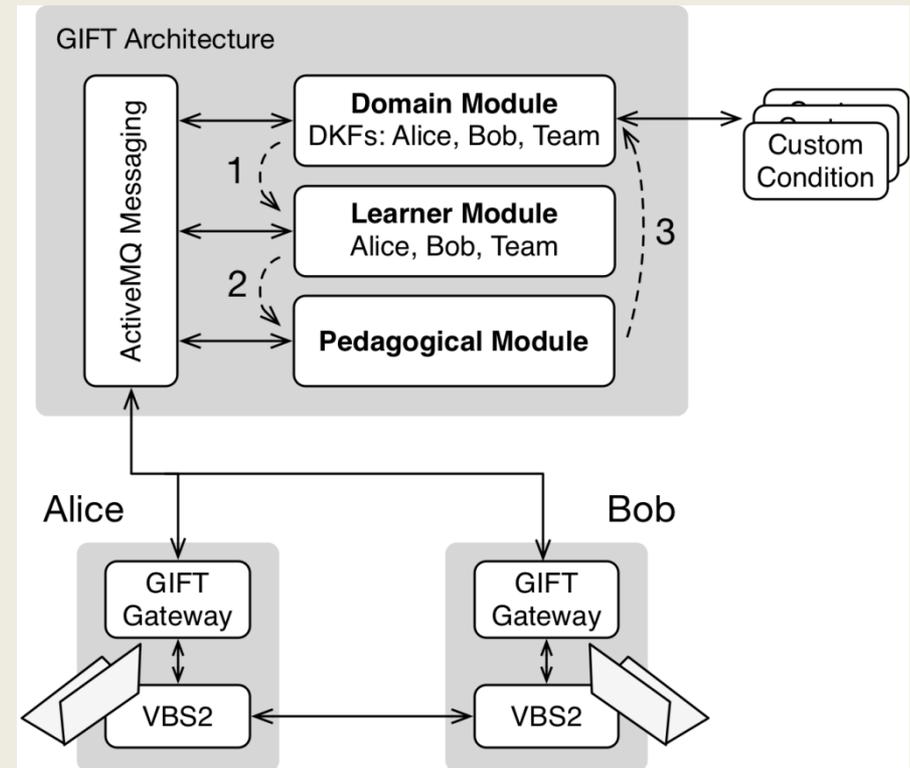
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GIFT Architecture – Surveillance Task Configuration

3 Domain Knowledge Files (DKFs):

- Learner 1 (Bob)
- Learner 2 (Alice)
- Team (Bob and Alice)



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Construct	Measure	Metric	Formula	Source
Individual Performance	Transfer Rate	Percentage transfers	$\frac{\# \text{ Transfers}}{\# \text{ OPFOR crossings}}$	Post-processing
	Acknowledge Rate	Percentage acknowledges	$\frac{\# \text{ Acknowledges}}{\# \text{ Transfers Rec'd}}$	Post-processing
	Identify Rate	Percentage Identifies	$\frac{\# \text{ Identifies}}{\# \text{ OPFOR Crossings}}$	Post-processing
	Identify Timing	Average time to Identify	$\frac{\sum_i^{Opfor} ID\ time_i - Trans\ time_i }{total\ OPFOR\ crossed}$	Post-processing
	Verbal Communication Rate	Percent Verbal Communications	$\frac{\# \text{ verbal comms.}}{\# \text{ comm. keystrokes}}$	Behavioral coding of recordings
Team Performance	Team Identify Rate	Total Percentage IDs	$\frac{\# \text{ Identifies from both players}}{\# \text{ OPFOR Crossings}}$	Post-processing
	Coordination	Percentage Paired	$\frac{\# \text{ Trans} - \text{Ack Pairs}}{\# \text{ Total Transfers}}$	Post-processing
	Backup Behavior	Percentage IDs w/o Transfer	$\frac{\# \text{ Identifies not transferred}}{\# \text{ OPFOR Crossings}}$	Post-processing
	Team Communication	Communication Count	$\# \text{ communications total}$	Behavioral coding of recordings

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Future Work:

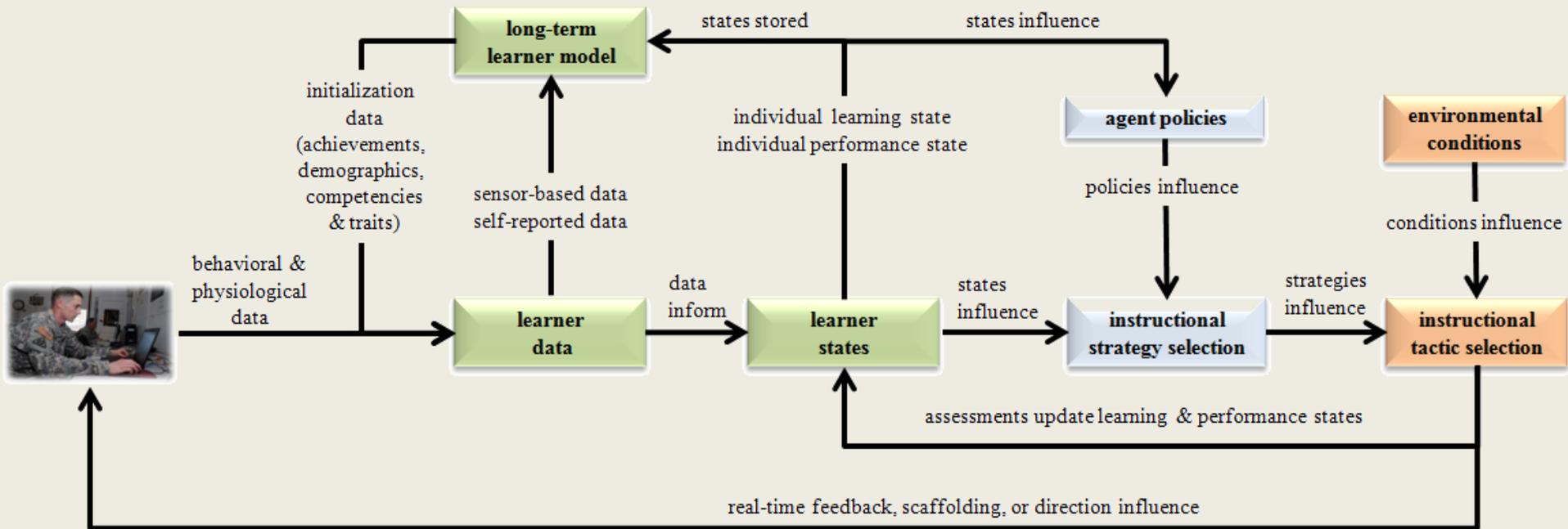
Scaling up the team task for three individuals, and different roles

Continuing to develop analysis methods to deal with team data

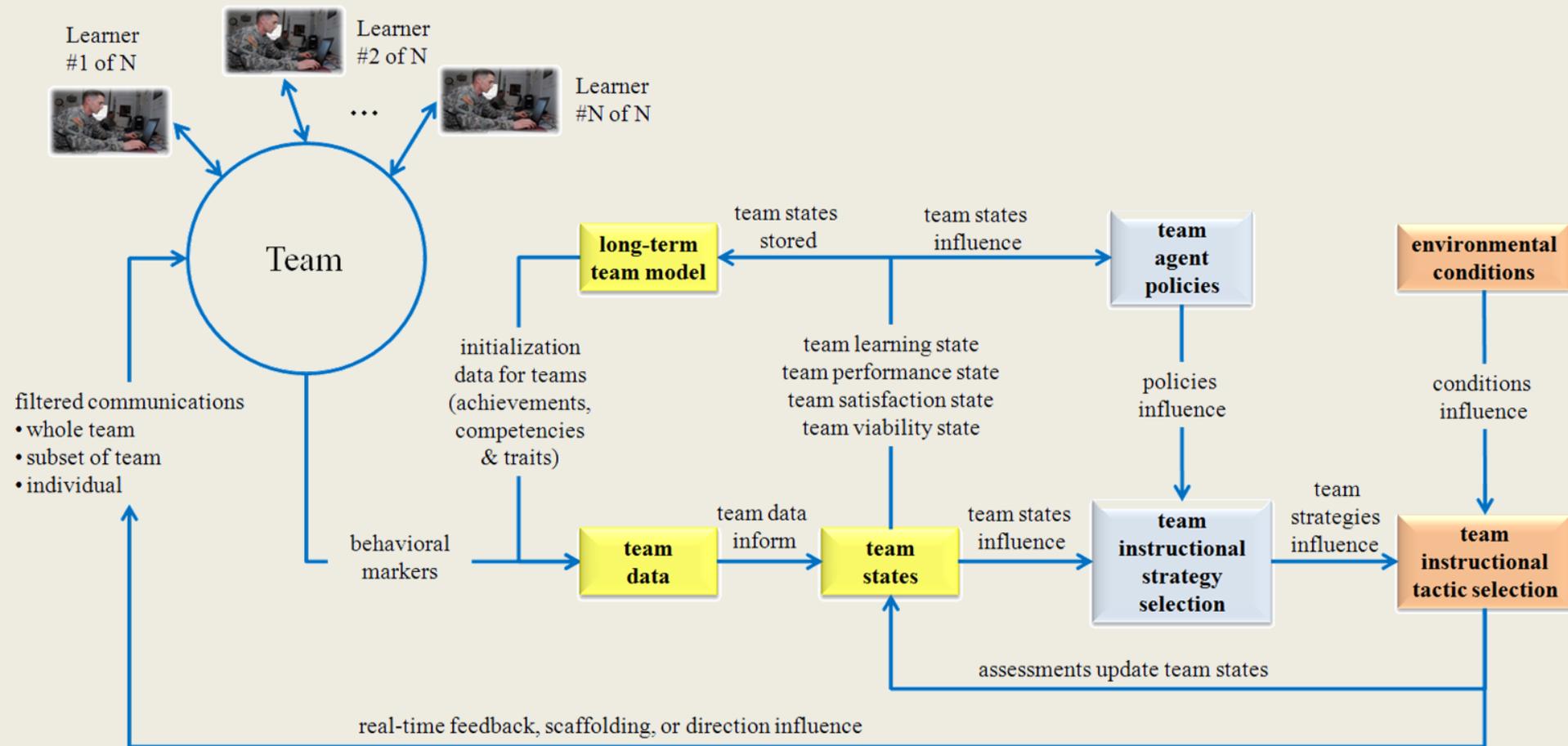


- Building Intelligent Tutoring Systems for Teams: What Matters
 - March 2016, Orlando, FL
 - Intended Output: Book
 - To be out-briefed at Team Modeling and Team Taskwork Expert Workshop

- Team Modeling and Team Taskwork Expert Workshop
 - June 2017, Ames, IA (Iowa State University Campus)
 - Focus on Team Taskwork
 - Intended Output: Design Recommendations in Intelligent Tutoring Systems Volume



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Steps Forward

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- Combining Theoretical Efforts with Authoring
 - Operationalizing Behavioral Markers
 - Determining how to move coding from a human to a computer in real time
- Scaling up the number of team members
 - Conducting studies with 3 team members
 - Impact on DKFs? Impact on GIFT?
- Considering what Authoring Tools and adjustments are needed for team tutoring
 - Keeping the number of team members and assessments flexible
 - Considering domain independence
 - How to deal with the increase in number of DKFs? Reuse?



Questions



Questions?



References

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References

- Gilbert, S.B., Sinatra, A.M., MacAllister, A., Kohl, A., Winer, E., Dorneich, M., Slavina, A., Bonner, D., & Ouverson, K.M. (in press). Analyzing Team Training Data: Aspirations for a GIFT Data Analytics Engine. Proceedings of the 5th Annual GIFT Symposium.
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