

Introduction to Approaches and Challenges in Team Tutoring

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Abstract. There are many challenges that are associated with the field of team tutoring. Intelligent tutoring for an individual is a difficult task, and it gets even more complex when a solution is scaled up to support team tutoring. Complex considerations include tracking of individual learners, team roles, overall team performance, and feedback time/frequency/type. Intelligent tutoring system (ITS) frameworks such as the Generalized Intelligent Framework for Tutoring (GIFT) are currently working on team tutoring implementations in a domain-independent fashion. As GIFT is a research project, lessons learned from other team tutoring systems are valuable and will help shape its development. The *Approaches and Challenges in Team Tutoring* Workshop included topics such as team tutoring, natural language processing, and collaborative learning. Additionally, there was discussion about what worked and did not work in existing implementations.

Keywords: Team Tutoring, Intelligent Tutoring Systems, Generalized Intelligent Framework for Tutoring

1 Approaches and Challenges in Team Tutoring

In June 2018, we chaired a workshop titled *Assessment and Intervention during Team Tutoring* in association with the Artificial Intelligence in Education (AIED) 2018 conference. We had a very positive response to that workshop, and through discussion that occurred during the workshop it was established that there were commonalities in the approaches and challenges that were being encountered even in very different domain areas. This led to the *Approaches and Challenges in Team Tutoring Workshop* at the AIED 2019 conference. While our original workshop contained six presentations from researchers, we had a very strong response to our 2019 workshop with nine papers selected for presentation. This increase in submissions demonstrates that team tutoring is an up-and-coming research area, and the submissions provide evidence that this area includes many challenging considerations.

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1.1 Team Tutoring

While developing intelligent tutoring systems (ITSs) is challenging, ITSs are often focused on tutoring an individual learner. It is typical that ITSs include common components, such as a learner module, pedagogical module, domain module, and a tutor-user interface [1]. Based on how it has been authored and configured, each ITS will differ in the approaches to assessment, feedback types, and characteristics of the learner that are being tracked and adapted upon. When altering individually oriented ITSs to address team tutoring there are many complex design considerations. Generally, team tutoring is not as simple as just summing the individual performance of each of the learners to arrive at a composite team model. Rather, the specific domain, domain-specific team structure, potentiality of team roles and use and purpose of feedback are all of particular interest. For example, in the important case of tracking and assessing communication amongst team members in real time, the methods to assess and subsequently inform adaptive content in real time becomes very, very complex [2].

1.2 Goals of this Workshop

The *Approaches and Challenges during Team Tutoring Workshop* covered both empirical and theoretical approaches to ITSs for teams. The papers included in these proceedings and presented at the workshop comprised many approaches and were grounded in different educational domains. Specific topics of discussion following these presentations included: mechanisms for enhancing an ITSs ability to process team communications; individual differences and their impact on team tutoring; collaborative problem solving; tools for assisting with authoring of team tutoring; and lessons learned from building team tutors.

A goal of this workshop was to provide a forum for researchers who continue to work in the field and expand their research, as well as new contributors in the field. The workshop included three follow up papers that built on work from our previous workshop, and work from six new contributors. Topics included: a framework for team evaluation; the need for sensors; challenges of natural language processing; lessons learned from large team training; tools for authors of team training; collaborative problem solving; characteristics of the individual that may impact team tutoring; and simulated students. Even though these topics sound varied, each paper identifies common challenges that are common in the domain of team tutoring systems. Some specific commonalities identified the need to understand and process what individual team members are doing in real time, and the capability of the team tutoring system to track individual states and provide distinguishable feedback for both individuals and for the team. In particular, the need to have an understanding of the communication that is occurring during the team tutoring was of particular importance, and was repeatedly identified as a thorny and difficult problem.

It is our intention that the outcomes of this workshop will help shape the steps forward for the Generalized Intelligent Framework for Tutoring (GIFT) project as it continues to be developed by the US Army CCDC Soldier Center and to address team tutoring while also providing valuable findings to the tutoring community at large.

2 The Generalized Intelligent Framework for Tutoring and Team Tutoring

GIFT is an open source and domain independent framework for creating ITSs. GIFT includes a number of authoring tools that allow instructors and subject matter experts who do not have a background in computer science to be able to author complete ITSs. GIFT includes the standard components of an ITS (i.e., learner, pedagogical, and domain modules) in addition to a sensor module and a gateway module, which allows communication with external computer programs or game environments [1]. Work has been on-going in GIFT to support team tutoring. Current challenges that have been encountered while making the shift from individual and team tutoring in GIFT are: how to deal with/process semantic information from real-time communications; how to account for team members that have different roles; how to track/assess individual team members as well as the team as a whole.

Initial work in this area includes a meta-analysis of the relevant team literature and the identification of behavioral markers that would be relevant to implement in GIFT [2]. Additionally, initial team tutoring work has been demonstrated through a Virtual Battlespace 2 (VBS2) team surveillance task, providing feedback to team members while they engaged in a scenario. The first iteration of the task included two team members (in the same role), and the second version had three team members (in two different roles) [3]. Current on-going work with GIFT has demonstrated team tutoring at the Squad level with a series of Search and Rescue scenarios in Virtual Battlespace 3 (VBS3) that are designed for nine team members. These scenarios include overall team assessments and after-action review feedback [4, 5]. Work is continuing on this project to improve the assessment and feedback occurring in real-time during the scenarios.

3 Implications of Team Tutoring Work to GIFT and other ITSs

One of the challenges of developing GIFT is that it is domain-independent. All of the procedures and authoring tools that are being developed need to work for multiple domains. This is even more challenging when different team tasks have different characteristics, team roles, and team configurations. Some of the lessons learned in varying domains are highly applicable to GIFT as they provide examples of unique implementations of team tutoring that have encountered specific challenges and addressed them. The lessons learned and outcomes of these works can help to influence the design of GIFT, and ITSs for teams in general.

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4 References

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